Escola de Camins
Escola Tècnica Superior d'Enginyeria de Camins, Canals i Ports
UPC BARCELONATECH

PROJECTE O TESINA D'ESPECIALITAT

Títol

Projecte de serveis logístics entre la Xina i el port de Barcelona

Autor/a

Nil Cabutí Borrell

Tutor/a

Mateu Turró Calvet

Departament

Infraestructura, transport i territori

Intensificació

Transports

Data

20/06/2014

Presentation

The submitted project was carried out at Port of Barcelona Chair of Logistics at China Europe International Business School (CEIBS), in Shanghai, China, from January 2014 to June 2014. The research was written under the supervision of Mateu Turró Calvet from UPC, Cristina Castillo Cerdà and Jaume Ribera Segura from CEIBS and Joan Dedeu from Port of Barcelona.

The project is divided into two parts.

The first part is about the logistics services in the containerized export flows from mainland China to Europe. The main purpose of this part was to analyse and model the current container flows from mainland China to Europe through the definition of key variables, their future changes and the optimisation measures to be adopted by Port of Barcelona in order to adapt to the new scenario. The research was complemented by the execution of interviews to the principal carriers currently operating maritime services from mainland China to the Mediterranean Europe.

It must be highlighted that difficulties were encountered in this part when contacting European ports for data about their maritime trade figures with mainland China and especially when contacting shipping companies based in China for executing the intended interviews. Sensitive information required and confidentiality policies were the main reasons for meeting such complications.

The second part is a construction project consisting in the urbanization of Street 114 and its connection to L'Estany del Port Avenue.

During the last years, Port of Barcelona has strengthened its willingness of providing newer and more efficient infrastructures for the reception of bigger vessels operating maritime services coming from the Far-East. Due to the south extension of Port of Barcelona (Tercat), new accesses to the Port had to be built in order to ensure the communication between the Port and its surroundings. The urbanization project here developed is inscribed in this context, and aims to be part of the improved infrastructure conditions of Port of Barcelona.

Acknowledgments

I would like to express my sincere gratitude to my thesis advisor, Professor Mateu Turró Calvet, who has consistently inspired me in this study and provided me precious suggestions and advice. Without his attentive guidance, endless patience and encouragement through the past year, this thesis would not have been possible to accomplish. Besides, I have also acquired valuable insights through his instructions, not only in academic studies but also enthusiasm and vigour in life.

My sincere thanks also go to Professor Jaume Ribera Segura and Cristina Castillo Cerdà, from CEIBS (Shanghai, China). They have provided me lots of constructive suggestions and comments not only on the structures and wordings but also the content of the thesis with their professional experience and extensive knowledge in research conducting.

Besides, I am grateful to Pol Bals, from Port of Barcelona, who offered me professional knowledge about the shipping industry, and also to Santiago Garcia Milà, José Alberto Carbonell, Joan Dedeu and Rosa Puig, who gave me key advices in their visit to Shanghai during my thesis elaboration.

Furthermore, I heartily thank my CEIBS' co-workers for their cooperation in conducting the research: Doris Ma, Kenny Xie, Claudia Schaefer, Roy Chason, Sandra Martínez, Harris, Pablo Cardona and Zhen Chen. Special appreciation is also extended to the carriers' professionals interviewed, who kindly attended my requests and without whom this research would not have been the same: Michael Zhang, Jiang Jianqiang, Diego Perdones, Elizabeth Tay, Pablo González, Jason Seo, Robert Lee and Yang Lei.

Sincere gratitude should be given to my dear friends in Shanghai for their company during the tough times in the pursuit of academic achievements. And also thanks to my friends and classmates in Barcelona for all their support since we started this journey together six years ago.

Last but not least, I am deeply appreciative of my beloved family, who have always supported me through the difficult times. It is their love and encouragement that have always pushed me to stick on the difficult task of writing the thesis.

CONTENTS

PART 1. THE LOGISTICS SERVICES IN THE CONTAINERIZED EXPORT FLOWS FROM MAINLAND CHINA TO EUROPE

PART 2. URBANIZATION PROJECT OF STREET 114. CONNECTION BETWEEN L'ESTANY DEL PORT AVENUE AND STREET 114 (PORT OF BARCELONA)

DOCUMENT Nº1. PROJECT REPORT AND ANNEXES

PROJECT REPORT

ANNEXES

DOCUMENT Nº2. PLANES

DOCUMENT Nº3. STATEMENT OF PARTICULAR TECHNICAL REQUIREMENTS

DOCUMENT Nº4. BUDGET

PART 1. THE LOGISTICS SERVICES IN THE CONTAINERIZED EXPORT FLOWS FROM MAINLAND CHINA TO EUROPE

0. Background

Europe is currently engaged in a debate about medium and long-term trends in long distance traffic, focusing on modal split and its impact on economic development and climate change. One important factor affecting long-distance intra-European freight traffic is the Asia-Europe container market, which has grown significantly as a result of globalisation, and in particular of the high proportion of world manufacturing having shifted to China. In Figure 1 the World container traffic evolution shows the relevance of the Europe – Far East route. From 1995 to 2012, container traffic in the Far East – Europe route rose from 5 to 20 million TEU.

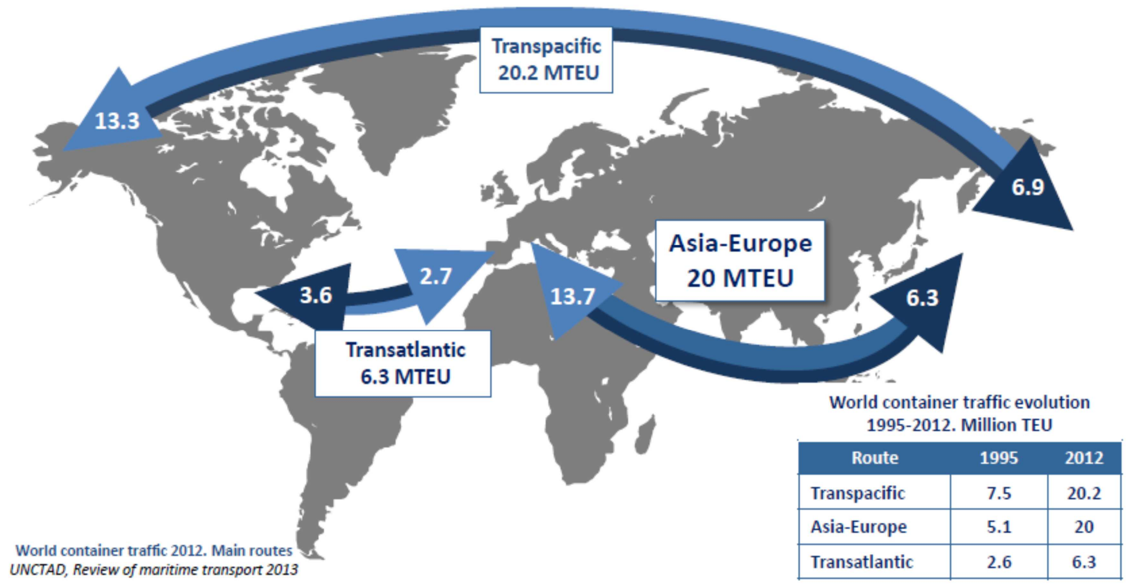


Figure 1. World container traffic 2012. Main routes (*source: UNCTAD, Review of maritime transport 2013*)

A large and growing proportion (43%) of European container traffic is related to trade via Suez. Historically, transatlantic routes, short-sea traffic, and other trade routes have been more prominent than those linking Asia and Europe, but if current trends continue, the dominance of the Suez-based traffic will continue to increase, since the canal is relatively unconstrained.

Most of the Asia-Europe traffic just uses the Mediterranean Sea as a route to the North of Europe. Potentially time and cost could be saved by diverting traffic from Northern to Southern ports, and yet, in a market where there are many competing ports and few restrictions in terms of port selection, shipping companies are still concentrating the largest volumes in the North.

European transport policy supports a certain division of traffic to Southern ports in order to maximise the economic and external benefits. In the 2011 European Commission White Paper, Article 392, referring to short sea shipping, states that:

"A European infrastructure policy for ports should pay particular attention to ensuring the availability of ports well connected to the land transport system along the entire EU coastline. For such an approach to allow over time a more balanced distribution of entry and exit flows into the European transport system, ports would also need to improve further the availability, quality and reliability of their services."

This suggestion of an adverse imbalance within the European networks for port related cargo raises the possibility of the EU supporting the "re-balancing" of the system. Although these statements focus on short sea shipping, it would not be possible to develop hinterland projects for short sea traffic without influencing distribution of ocean cargo as well.

The challenge is to define what might be understood by "a more balanced distribution". Balance could be interpreted as the achievement of a superficial symmetry either within or between coastal ranges, but instead, an alternative view based on a broader range of criteria might be offered.

In terms of Asia-Europe container flows, it is necessary to examine the combination of maritime and inland transport, treating port choice as a potential variable, to understand the logic of the *status-quo*, and the potential impacts of future changes in order to optimise the transport system.

At a micro level, the mathematics appears straightforward. Munich to a Benelux port is 830 km by road while Munich to an Adriatic port is around 550 km. The sailing distance between Italy and the Rhine delta is 4815 km. A Chinese container destined to Munich could save 280 land km and 4815 sea km by switching from North to South.

While such examples appear to lend *prima facie* support for the likelihood and benefit of a North to South shift, they cannot be used to provide conclusive evidence of market failure since they do not explain why transport companies freely choose current distribution patterns. Single origin-destination examples also do not provide the complete picture because shipping lines operate hub and spoke networks rather than point to point services. The analysis therefore needs to be system-based rather than case-based.

This requires an analysis of maritime as well as inland transport and distribution systems, and therefore the examination of typical calling patterns by the major carriers on the Asia-Europe trade-lane. Far Eastern containers typically arrive in Europe via Suez on large, dedicated container vessels. To maximise the benefits of scale, the number of port calls are relatively low and concentrated at the beginning and end of the rotation. A typical example from Maersk Line, the largest carrier on this route, is shown below. In this Maersk service, containers bound for Europe are collected from four Chinese ports and then from Tanjung Pelepas in Malaysia. After Suez, the ships in this Maersk schedule deliver cargo destined to Mediterranean European and

African countries at the hub port of Tangier in Morocco, and then continue to the North Sea to deliver the North European cargo at Felixstowe (UK), Bremerhaven (DE) and Rotterdam (NL). Other carriers offer similar calling patterns, alternatively calling at Antwerp, Hamburg and Southampton for example in North Europe.

Figure 2. Typical Asia-Europe Liner Service, Maersk, AE7 (*source: Maersk*)

This example indicates that container lines, who operate in a competitive environment, with a high degree of control over their maritime operations, are attempting to optimise their networks, and not to maximise the number of direct port to port connections. Hubs in the Mediterranean and South East Asia provide access to regional networks. Like airline networks, these container networks show a high degree of specialisation and evolution. External actions that might aim to influence port choice must therefore consider the wider maritime network implications besides the hinterland effects.

Thus, it is necessary to consider how much it costs to divert a line away from the traditional long distance sea lanes, and what is the trade-off between the length of the maritime leg, the ship size and the quality and cost of the port of call, including its hinterland connections.

Although the traffic between Europe and Far East Asia involves a lot of variables that may derive to a wide range of different studies, the direction of the traffic (import/export), the type of cargo, the units used (tonnes, number of TEU, number of cars transported, etc.), etc., this study will focus on the traffic of large containers from China to the main Southern European Ports. Moreover, the maritime trade from China to Spain and Barcelona will be deeply analysed.

1. Introduction

The information of this chapter is extracted from Eurostat, a Directorate-General of the European Commission located in Luxembourg. Its main responsibilities are to provide statistical information to the institutions of the European Union (EU) and to promote the harmonisation of statistical methods across its member states and candidates for accession as well as EFTA countries. One of the main areas of statistical activities is transport, including maritime, road, railway, air, inland waterways and oil pipeline transport.

1.1. General trade of goods China-EU

EU-27 international trade in goods with the rest of the world (the sum of extra-EU exports and imports) was valued at 3.478 billion euros in 2012, a record level for both imports and exports. In comparison with a year before, total trade in goods for the EU-27 increased by 210.446 millions of euros in 2012.

In 2012 the EU-27 leaded the world's value of total exports (1.686.295 millions of euros), followed by China (excluding Hong Kong) (1.594.631 millions of euros) and the United States (1.202.962 millions of euros). Concerning the imports in 2012, the United States leaded the total imports economic value (1.816.474 millions of euros), followed by the EU-27 (1.791.618 millions of euros) and China (excluding Hong Kong) (1.415.161 millions of euros). In Figure 3 and Figure 4, the import and export shares in terms of the weight of goods is provided.

In 2012, EU-27 exports of goods to all of its major trading partners increased. The highest growth rate was recorded for exports to Switzerland and Russia (up 26,2% and 25,9%, respectively), while exports to the United States grew more slowly (up 7,6%). However, the United States remained, by far, the most important destination of goods exported from the EU-27 in 2012, although the share of EU-27 exports destined for the United States fell from 27,8% of the total in 2001 to 16,8% by 2012.

On the import side, the EU-27 saw an increase in the level of its imports of goods from all of its major trading partners in 2012, except for imports from South Korea, which fell by 8,4%. China remained the most important supplier of goods imported into the EU-27 in 2012. EU-27 imports from Russia rose by 24,4% and, as a result, Russia replaced the United States as the second biggest supplier of goods into the EU-27 in 2012.

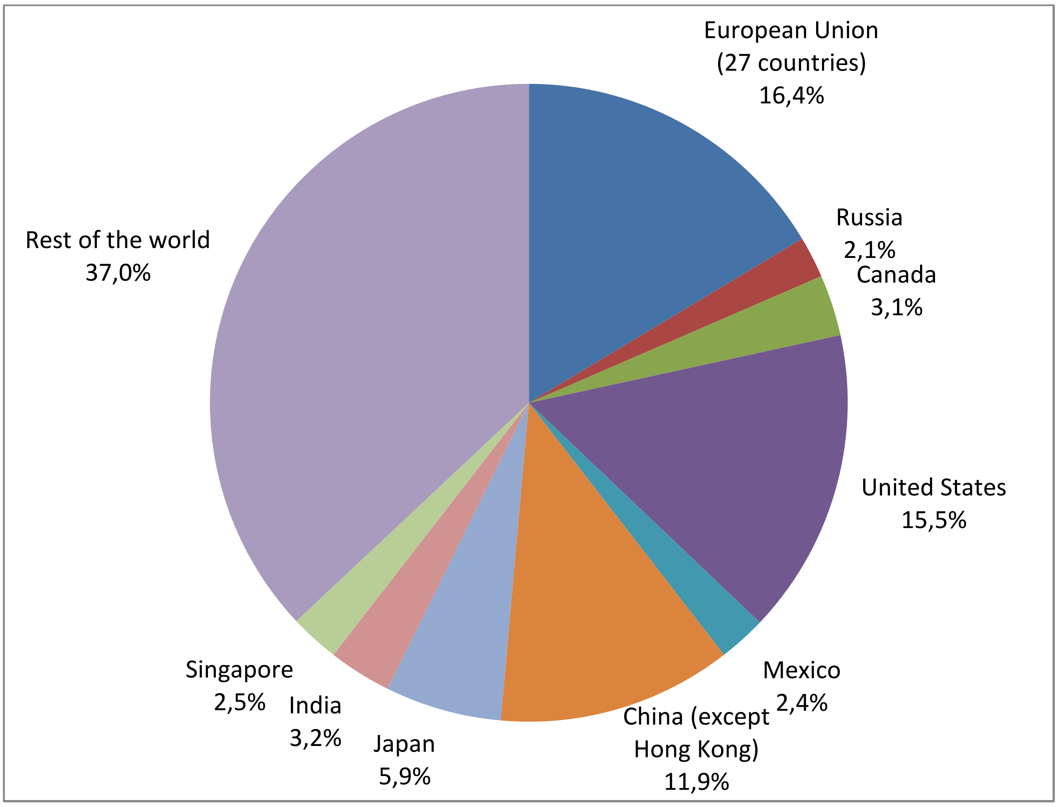


Figure 3. External trade, import shares in the world market, 2012 (%share of world total imports) (*source: own-source using Eurostat data*)

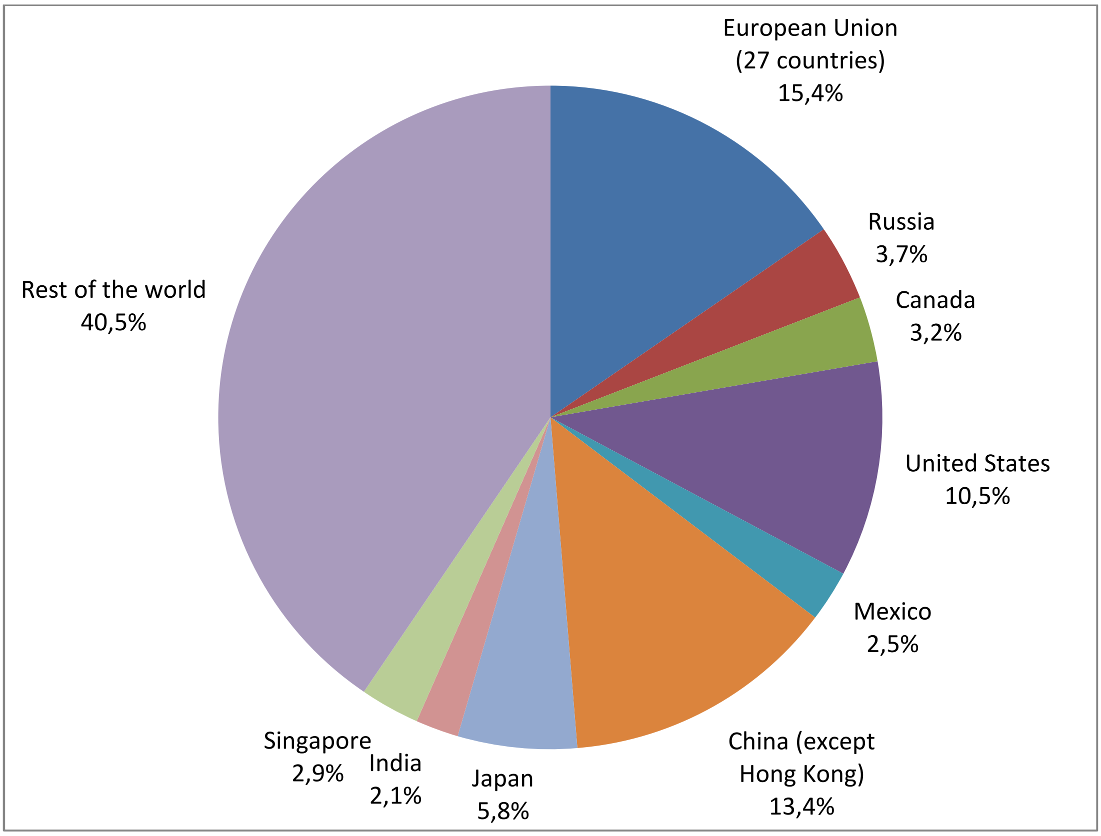


Figure 4. External trade, export shares in the world market, 2012 (% share of world total exports) (*source: own-source using Eurostat data*)

In addition, the EU-27's trade deficit 105.323 millions of euros in 2012 was driven by the sizeable deficit in relation to mineral fuels and lubricant products, which stood at 421.398 millions of euros. This was offset by trade surpluses of 256.130 millions of euros for machinery and transport equipment, and 114.142 millions of euros for chemical and related products.

Table 1. Extra EU-27 trade by main products, EU-27, 2006 and 2012 (*source: own-source using Eurostat data*)

	2006 (1.000 million EUR)	**(%)**	**2012** (1.000 million EUR)	**(%)**
EXPORTS				
Total	1161,9	100,0	1686,3	100,0
Food, drinks and tobacco	57,9	5,0	99,6	5,9
Raw materials	28,5	2,5	47,5	2,8
Mineral fuels, lubricants	59,0	5,1	123,7	7,3
Chemicals and related products	184,6	15,9	276,0	16,4
Other manufactured goods	294,2	25,3	382,1	22,7
Machinery and transport equipment	509,6	43,9	707,1	41,9
IMPORTS				
Total	1363,9	100,0	1791,6	100,0
Food, drinks and tobacco	67,9	5,0	92,8	5,2
Raw materials	63,2	4,6	80,9	4,5
Mineral fuels, lubricants	339,6	24,9	545,1	30,4
Chemicals and related products	109,2	8,0	161,8	9,0
Other manufactured goods	341,6	25,0	387,2	21,6
Machinery and transport equipment	412,5	30,2	450,9	25,2
TRADE BALANCE				
Total	-202,0	-	-105,3	-
Food, drinks and tobacco	-10,0	-	6,8	-
Raw materials	-34,7	-	-33,4	-
Mineral fuels, lubricants	-280,6	-	-421,4	-
Chemicals and related products	75,4	-	114,2	-
Other manufactured goods	-47,4	-	-5,1	-
Machinery and transport equipment	97,1	-	256,2	-

1.2. Maritime trade of goods from the EU

The total quantity of freight handled in EU ports in 2012 was 3,73 billion tonnes, indicating the important role maritime freight transport plays, particularly in extra-EU trade. Maritime transport decreased by 0,1% in quantity terms from 2011 to 2012, having fallen 12,1% in 2009, reflecting the impact of the financial and economic crisis. Between 2006 and 2012, fourteen European Member States presented decreases in goods freight transport by sea. The highest decreases were recorded in Croatia (-28%), Cyprus (-19%) and Denmark (-18%); in contrast the highest increases were observed in Lithuania (51%) and Latvia (28%).

Seaports in the Netherlands handled 543 million tonnes of goods in 2012, while the UK, Italy and Spain followed with 501, 477 and 422 million tonnes, respectively. These four Member States collectively handled 45% of total EU-28 seaborne freight.

Table 2. Goods freight transport by sea (gross weight of seaborne goods handled in all ports in thousands of tonnes) (*source: own-source using Eurostat data*)

	2006	2007	2008	2009	2010	2011	2012
EU-28	3.862.295	3.967.626	3.947.892	3.468.898	3.669.940	3.770.121	3.732.497
Belgium	218.941	236.320	243.819	203.368	228.228	232.789	223.987
Bulgaria	27.513	24.900	26.576	21.893	22.946	25.185	26.012
Denmark	107.674	109.660	106.096	90.636	87.068	92.613	87.827
Germany	302.789	315.051	320.636	262.863	275.953	296.037	298.758
Estonia	49.998	44.964	36.191	38.505	46.026	48.479	43.503
Ireland	53.326	54.139	51.081	41.829	45.071	45.078	47.649
Greece	159.425	164.300	152.498	135.430	129.059	135.314	152.983
Spain	414.378	426.648	416.158	363.536	376.376	403.694	422.152
France	350.334	346.825	351.976	315.534	313.593	322.251	302.997
Italy	520.183	537.327	526.219	469.879	494.091	499.885	476.823
Cyprus	7.676	7.516	7.962	6.808	6.954	6.564	6.236
Latvia	56.861	61.083	61.430	60.088	58.691	67.016	72.723
Lithuania	27.235	29.253	36.379	34.344	37.869	42.661	41.033
Malta	5.452	5.254	5.501	5.507	6.004	5.578	5.511
Netherlands	477.238	507.463	530.359	483.133	538.702	532.717	543.247
Poland	53.131	52.433	48.833	45.079	59.507	57.738	58.825
Portugal	66.861	68.229	65.275	61.714	65.981	67.506	67.875
Romania	46.709	48.928	50.458	36.094	38.122	38.918	39.520
Slovenia	15.483	15.853	16.554	13.356	14.591	16.198	16.907
Finland	110.536	114.819	114.725	93.239	109.326	115.452	105.120
Sweden	180.487	185.057	187.778	161.823	179.579	177.093	172.976
United Kingdom	583.739	581.504	562.166	500.863	511.875	519.495	500.860
Croatia	26.325	30.097	29.223	23.377	24.329	21.862	18.972
Iceland	5.917	-	-	-	-	-	-

Norway	196.818	198.507	193.368	182.635	195.132	198.970	205.959
Turkey	-	-	305.271	293.906	338.078	359.082	374.714

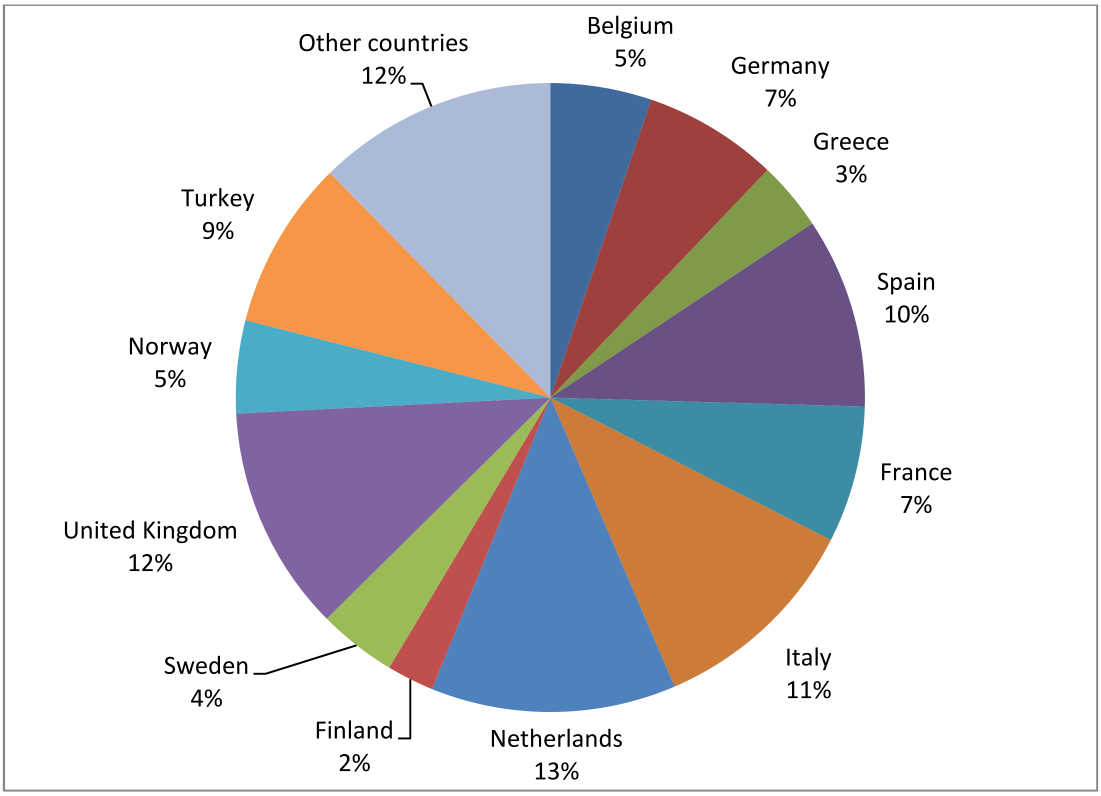


Figure 5. Share of goods freight transport by sea, EU-28, 2012 (percentage over the total gross weight of goods handled in all ports) (*source: own-source using Eurostat data*)

Table 3 identifies the regions within the EU-27 handling the largest quantities of maritime freight transport. Handling of maritime freight within the EU-27 is clearly focused on ports in the North Sea regions. It is important to note that traffic between EU ports is counted twice. This includes feeder services distributing containers from the main hubs. It is also important to note that most of the weight of maritime traffic comes from oil and bulk cargo.

The region of Zuid-Holland in the Netherlands, with the port of Rotterdam, handled by far the largest quantity of maritime freight; 378 million tonnes in 2011, more than double the quantity of the second-ranked region, Antwerpen in Belgium, which in turn was more than three times the quantity of the third-ranked region of Hamburg (Germany); all three of these regions are on the North Sea. The French regions of Haute-Normandie (including the ports of Le Havre and Rouen) and Provence-Alpes-Côte d'Azur (including Marseille) handled the largest quantity of maritime freight on the North-East Atlantic and Mediterranean coastlines respectively. The largest quantities of maritime freight handled in EU coastal regions on the Baltic coast were in Latvia, while the South-East region of Romania had the highest quantity of freight on the EU's Black Sea cost, its 37 million tonnes in 2011 ranking 31st among the EU regions. Vestlandet in Norway recorded the highest level of maritime freight in 2011 among the EFTA coastal regions, its 70 million tonnes of freight was just above the quantity recorded for Bremen (Germany), the 12th ranked EU coastal region. Among the regions within the acceding and candidate countries, the Turkish region of Hatay, Kahramanmaras, Osmaniye (including the Mediterranean port of Iskenderun) recorded 90 million tonnes of maritime freight in 2011, higher than in all but three of the EU coastal regions.

The downturn in the level of maritime freight transport in 2009 as a consequence of the global financial and economic crisis was visible in all of the top regions, as was the pick-up in 2010 in most regions. Developments in 2011 were more varied, with the two Dutch regions of Noord and Zuid-Holland and Andalucía in Spain experiencing relatively large falls, whereas Bremen, the Comunidad Valenciana (Spain) and Latvia all recorded double-digit growth.

Table 3. EU-27 regions with the highest quantity of goods transported by sea, 2008-2011 (*source: Eurostat*)

Region	Ports with more than 1 million tonnes of freight per year	Freight, 2011 (thousand tonnes)	Annual rate of change (%)			
			2008	2009	2010	2011
Zuid-Holland (NL33)	Rotterdam, Vlaardingen, Dordrecht	377 884	2.4	−7.5	12.6	−7.2
Prov. Antwerpen (BE21)	Antwerpen	168 547	3.5	−17.0	12.6	5.3
Hamburg (DE60)	Hamburg	114 368	0.6	−20.3	10.3	9.4
Haute-Normandie (FR23)	Le Havre, Rouen	87 247	2.0	−7.2	−1.2	−4.3
Provence-Alpes-Côte d'Azur (FR82)	Marseille	84 643	0.6	−13.1	2.0	2.6
Sicilia (ITG1)	Augusta, Catania, Gela, Lipari, Milazzo, Messina, Palermo, Porto Empedocle, Pozzallo, Santa Panagia, Termini Imerese, Trapani	84 619	−6.6	−15.8	22.4	−0.1
Andalucía (ES61)	Málaga, Sevilla, Algeciras, Huelva, Almeria, Cádiz	81 317	−5.7	−14.6	6.8	−8.5
Noord-Holland (NL32)	Amsterdam, Velsen/Ijmuiden	81 093	16.2	−12.3	5.0	−10.1
East Yorkshire and Northern Lincolnshire (UKE1)	Grimsby and Immingham, Rivers Hull and Humber, Hull, Goole, Trent River	79 831	−1.8	−15.7	−0.1	4.2
Comunidad Valenciana (ES52)	Valencia, Castellón de la Plana, Alicante	77 817	6.4	−6.8	9.3	16.0
Liguria (ITC3)	Genova, La Spezia, Savona	71 850	−1.4	−8.2	−4.0	2.3
Bremen (DE50)	Bremerhaven, Bremen	68 782	7.2	−15.1	9.6	16.4
Cataluña (ES51)	Barcelona, Tarragona	65 822	−3.7	−6.7	−2.7	−1.4
Latvija (LV00)	Rīga, Ventspils, Liepaja	65 394	0.8	−2.3	−2.6	14.6
West Wales and The Valleys (UKL1)	Milford Haven, Port Talbot, Holyhead	59 809	−1.4	−1.1	15.0	8.2

The quarterly evolution of the total maritime transport, the total maritime import and the total maritime export of both loaded and empty TEU from the European Union from the year 2000 until the second semester of 2013 are shown in Figure 6, Figure 7 and Figure 8, respectively. The EU during this period had 15 members until 2004 and 28 members from 2005. Although in the three cases there was a constant slightly increasing tendency from 2000 to 2008, a significant downfall occurred in 2008 due to the European economic crisis. In the three cases, as well, there was a subsequent recover, but in the second semester of 2013 the values were still below the ones in 2008, both for imports and exports. In addition, the influence of mainland China in the total maritime transport of TEU from the European Union is now much higher than in the year 2000.

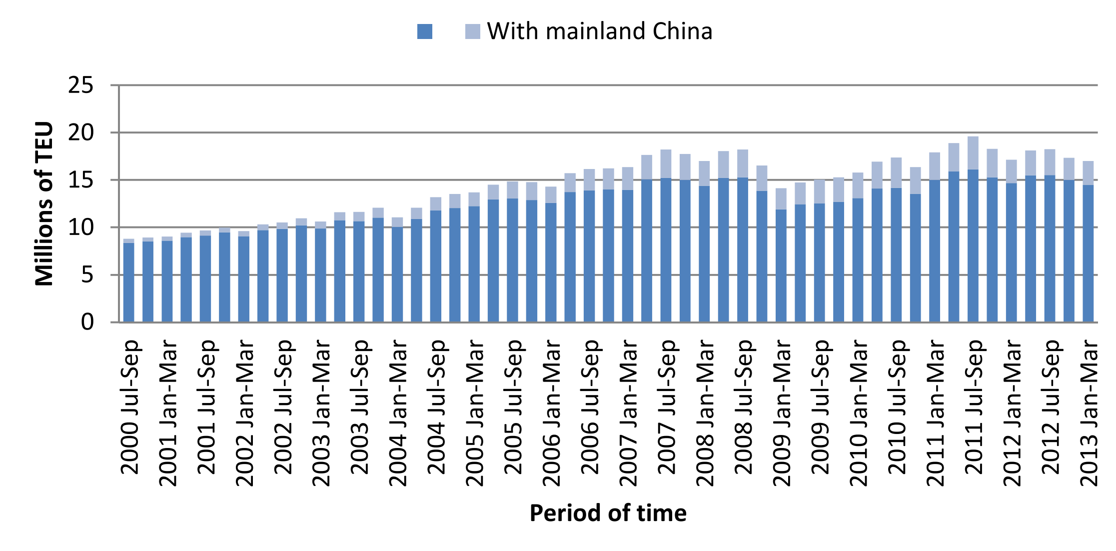


Figure 6. Total maritime transport of both loaded and empty TEU from the European Union (*source: own-source using Eurostat data*)

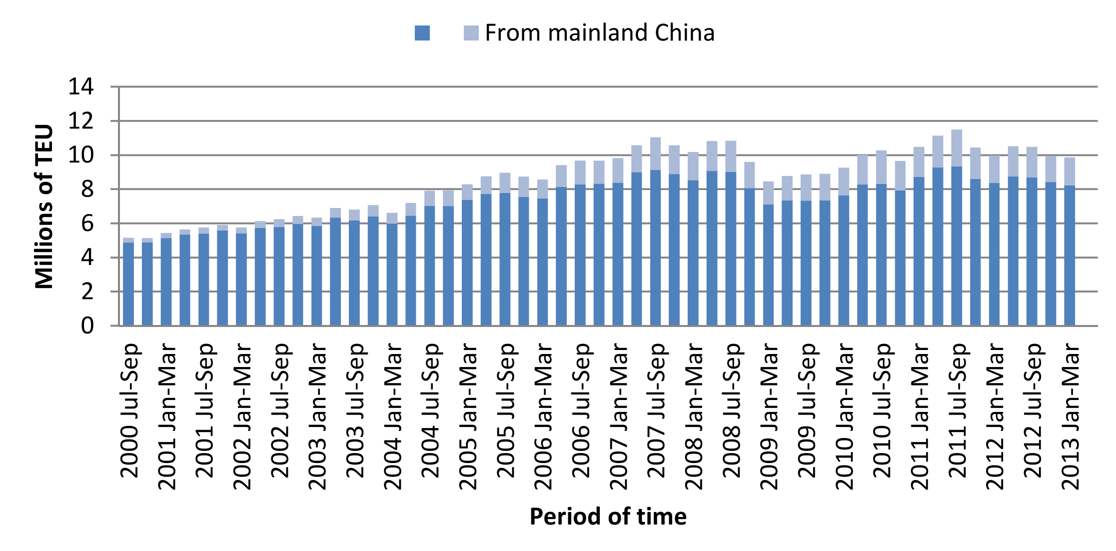


Figure 7. Total maritime import of both loaded and empty TEU from the European Union (*source: own-source using Eurostat data*)

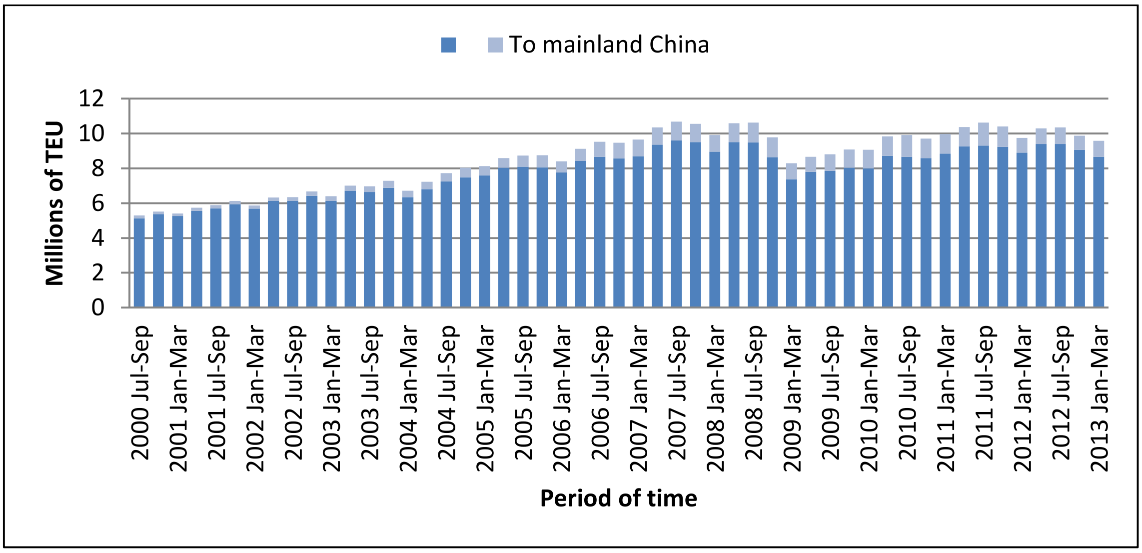


Figure 8. Total maritime export of both loaded and empty TEU from the European Union (*source: own-source using Eurostat data*)

1.3. European hinterland distribution

Concerning the modal split of inland freight transport, in the last decade a shift towards road transport has been recorded, especially in newer Member States. The highest increases in the shares of road freight transport were observed in Slovakia (23 percentage points), Poland (18), Estonia (17) and Bulgaria (13). This is mostly thanks to the Russian traffic to the Baltic Sea area.

In contrast, eleven Member States presented a shift towards more environmentally friendly transport modes, most notably Belgium and Austria. In 2011, road transport made up over half of freight transport in all Member States, except for Latvia and Estonia, where railway transport accounted for the largest share (64% and 52%, respectively). High shares of rail transport were also recorded in Lithuania (41%), Austria (40%) and Sweden (38%). Considerable shares of inland waterways were recorded in Netherlands (37%), Romania (21%) and Belgium (19%).

In the whole European Union, however, a relatively constant modal split of inland freight transport has been recorded in the last decade. In 2001, road freight transport represented 75% of the total, rail freight transport 19%, and inland waterways transport 6%. In 2010 and 2011, these percentages were 76, 18 and 6, respectively.

Reported data from Port de Barcelona using the modal split transport model Trans-tools shows that in 2005, road freight transport represented 72% of the total, rail freight transport 22% and inland waterways transport 6%. These percentages fairly agree with the ones offered by Eurostat. Trans-tools (“Tools for transport forecasting and scenario testing”) is a European transport network model that has been developed in collaborative projects funded by the European Commission Joint Research Centre’s Institute for Prospective Technological Studies

(IPTS) and DG TREN. The various Commission services addressing transport issues have agreed to use Trans-tools as the main model for policy analysis and have appointed IPTS as the model's reference centre. According also to this model, if in the modal split reported we include Short Sea Shipping, then the new modal split of freight transport would be: 43% road, 43% rail, 3% inland waterways, 40% Short Sea Shipping. These data can be used as a reference when coming to analyse the maritime trade between China and Europe, concerning the shipments that use Short Sea Shipping once they land in Europe.

In Table 4 and Figure 9, rail and inland waterways transport are based on movements on national territory, regardless of the nationality of the vehicle or vessel. Road transport is based on all movements of vehicles registered in the reporting country and covers only the haulage of heavy good vehicles (usually > 3,5 tonnes load capacity). Moreover, it is important to say that only the countries with international or transit transport exceeding 1 million tonnes report their data to Eurostat.

Table 4. Modal split of inland freight transport - shares of road, rail and inland waterways in total freight transport (% of total inland freight tonne-km) (*source: Eurostat*)

	2001			2010			2011		
	Road	Railway	IWW	Road	Railway	IWW	Road	Railway	IWW
EU-28	:	:	:	:	:	:	:	:	:
EU-27	75	19	6	76	17	7	76	18	6
BE	78	10	11	68	15	18	66	15	19
BG	60	37	3	68	11	21	74	11	15
CZ	70	30	0	79	21	0	79	21	0
DK	92	8	–	87	13	–	86	14	–
DE	67	19	15	65	22	13	66	23	11
EE	31	69	0	46	54	–	49	52	–
IE	96	4	–	99	1	–	99	1	–
EL	98	2	–	98	2	–	97	3	–
ES	93	7	–	96	4	–	96	5	–
FR	78	19	3	82	14	4	81	15	4
HR	76	23	1	71	21	8	74	20	6
IT	89	11	0	90	10	0	88	12	0
CY	100	–	–	100	–	–	100	–	–
LV	27	73	0	38	62	–	36	64	–
LT	52	48	0	59	41	0	59	41	0
LU	90	7	4	94	3	4	94	3	3
HU	68	28	4	75	20	5	76	20	4
MT	100	–	–	100	–	–	100	–	–
NL	63	3	34	62	5	33	58	5	37
AT	66	30	5	56	39	5	56	40	4
PL	62	38	0	81	19	0	79	21	0
PT	93	7	–	94	6	–	94	6	–
RO	50	43	7	49	24	27	50	28	22
SI	73	27	–	82	18	–	81	19	–
SK	54	42	4	75	22	3	77	21	2
FI	75	24	0	75	25	0	74	26	0
SE	64	36	–	61	39	–	62	38	–
UK	89	11	0	89	11	0	87	13	0
IS	100	–	–	:	–	–	:	:	:
LI	:	:	–	97	4	–	:	:	:
NO	84	16	–	85	15	–	84	16	–
CH	56	44	–	54	46	–	54	46	–
MK	87	13	–	:	:	:	:	:	:
TR (1)	95	5	–	:	:	:	:	:	:

(1) In the case of road transport only national transport data have been used.

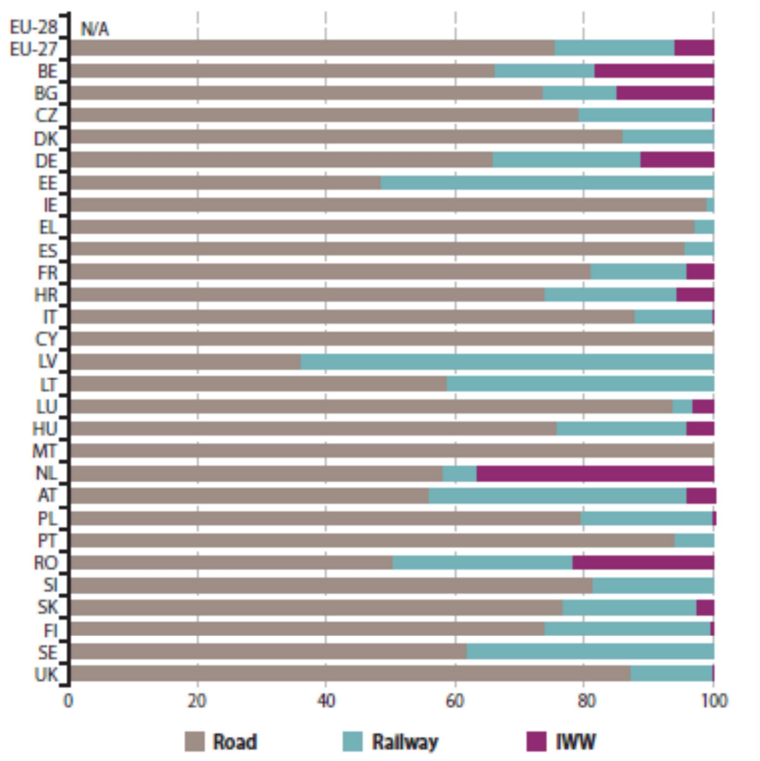


Figure 9. Modal split of inland freight transport, 2011 (% of total inland freight tonne-km) (*source: Eurostat*)

1.4. European inland waterways

Inland waterway transport plays an important role for the transport of goods in some part of Europe. More than 37,000 km of waterways connect hundreds of cities and industrial regions. Some 20 out of 27 Member States have inland waterways, 12 of which have an interconnected waterway networks.

The potential for increasing the modal share of inland waterway transport is not very significant. Compared to other modes, inland waterway transport is characterized by its low operational costs, low environmental impact and its free capacity, which would allow for increased exploitation. It offers an environmentally friendly alternative in terms of both energy consumption and noise and gas emissions. Its energy consumption per ton-km of transported goods is approximately 17% of that of road transport and 50% of rail transport. Its noise and gaseous emissions are modest. In addition, inland waterway transport ensures a high degree of safety, in particular when it comes to the transportation of dangerous goods. Finally, it may contribute to the decongestion of the overloaded road network in densely populated regions. According to the recent studies, the total external costs of inland navigation (in terms of accidents, congestion, noise emissions, air pollution and other environmental impacts) are seven times lower than those of road transport.

However, only a few EU rivers are adapted to a modern exploitation of inland navigation (see Turró, 1999). The Rhine and the Danube, now connected via the Main river, are the main arteries. In particular the Rhine, which connects without locks the ports of Rotterdam and Antwerp and some others in the North Sea to most of the industrial regions of Germany and all the way to Switzerland. Besides some Rhine affluent, the Elbe and the Rhone, waterway traffic is marginal. Draft problems limiting the size of barges, the need for locks and the problems derived from floods and low water, severely limit the use of this mode of transport, which is mostly used for bulk cargo. Container traffic is only significant in the Rhine. In spite of some (very expensive) proposals to extend the network, the potential of inland navigation to play a significant role in China – EU container traffic is limited to the Rhine corridor.

2. Diagnosis, analysis and modelling of the current container flows from mainland China to Europe

2.1. European and Mediterranean port analysis

When analysing the China-Europe shipping, there are several categories within the statistics:

- Deep-sea import/export cargo. In other words, containers arriving (in the case of imports) from outside Europe (in this case China) into a European port and then moving into the hinterland by road, rail or waterway.

- Short-sea import/export cargo. That is, containerised intra-European and intra-Mediterranean trade.

- Transhipment. This means containers that arrive in a port by sea, and then leave on another container ship. Transhipment usually provides a link between ocean-going mother ships and regional feeder services. Such regional (e.g. Mediterranean or Baltic) feeder services, which bring extra-European trade into the ultimate point of unloading in Europe need to be distinguished from short-sea flows.

Most container ports handle a mix of these categories, but this study focuses on deep-sea container flows and the transhipment of these mother ships into regional feeder services. All this in order to build a map of the current situation in the maritime transport of TEU from mainland China to Europe. That is to say, how many TEU are transported from mainland China to each European port, how many of them are distributed to the hinterland and how many of them are redirected either by Short Sea Shipping or by a transoceanic route to another destination.

Short-sea import/export container volumes are harder to estimate per port. Short sea unit loads are carried on both container and Ro-Ro services. However, as the main focus of this study is the trade between China and Europe, the Short-sea traffics between European countries are not of first order importance.

The ports that will be analyzed in order to know their current role as a hub and feeder center are the following: Barcelona, Genova, Gioia Tauro, Malta, Marseille Fos, Valencia, Cagliari, Algeciras and Tanger MED. However, information about imports and exports from other European ports – Hamburg, Rotterdam, Felixstowe, Bremerhaven, Le Havre, Southampton, Ambarli, Piraeus, Antwerpen, Zeebrugge, Gdansk, La Spezia, Sines and Bilbao – will also be provided in order to show the current situation of the transport of TEU from mainland China to Europe.

The information about the transport of TEU from mainland China to Europe and the following transshipment on another container ship was not always easy to find. Some of the ports mentioned above do not make public their trade data, and in the case they do, the specific information required for this study is not available. Thus, some hypothesis have been made in some cases in order to estimate the real situation.

For each port, an historic series data has been built, but only the most recent data about imports and transshipment rates has been used in order to configure the current map of the transport of goods from mainland China to the main European ports. Despite the enormous type of cargo that can be shipped from China to Europe, such as dry bulk goods, liquid bulk goods, Ro-Ro, etc., this study is only focused on the containers shipping, measured in TEU.

On the other hand, a distinction has been done between loaded TEU and empty TEU. After a meeting with the Port of Barcelona Director, it was decided that not only was important to determine the total amount of TEU transported to each port, but also to know what is the percentage of loaded TEU above the total. Therefore, in the following analysis both loaded and empty TEU has been taken into account, in order to figure out what is the real movement of goods from each port.

2.1.1. Barcelona

The Port of Barcelona has a 2000-year history and great contemporary commercial importance. It is the Catalonia's largest port, vying with Tarragona, and Europe's tenth largest container port, with a trade volume of 1.72 million TEU in 2013. It is also one of the most important ports in the Mediterranean. The port is managed by the Port Authority of Barcelona. Its 7,86 km^2 are divided into three zones: Port Vell (the Old Port), the commercial/industrial port and the logistics port (Barcelona Free Port). The port is undergoing an enlargement that will double its size by diverting the mouth of the Llobregat river 2 km to the south, and slightly pushing back the Llobregat Delta Nature Reserve.

As a hub port, Barcelona is directly connected to 200 ports with 86 maritime services and 62 shipowners. It has weekly connections with the main ports in the World and has available a network of feeder and SSS services. The principal competitors of Barcelona as a hub port in the Mediterranean Sea are Genova, Gioia Tauro, Marseille Fos, Malta, Cagliari, Valencia, Tanger MED and Algeciras.

As a gateway port, Barcelona serves the biggest industrial and consumption coastal area in the Mediterranean Sea, together with Istanbul. The proximity to the main industrial, logistics and consumption centres in Europe is evident: 300 km to Zaragoza and Toulouse, 600 km to Madrid, Lyon and Alger, and 1.000 km to Lisbon, Paris, Milano, Zurich and Tangier.

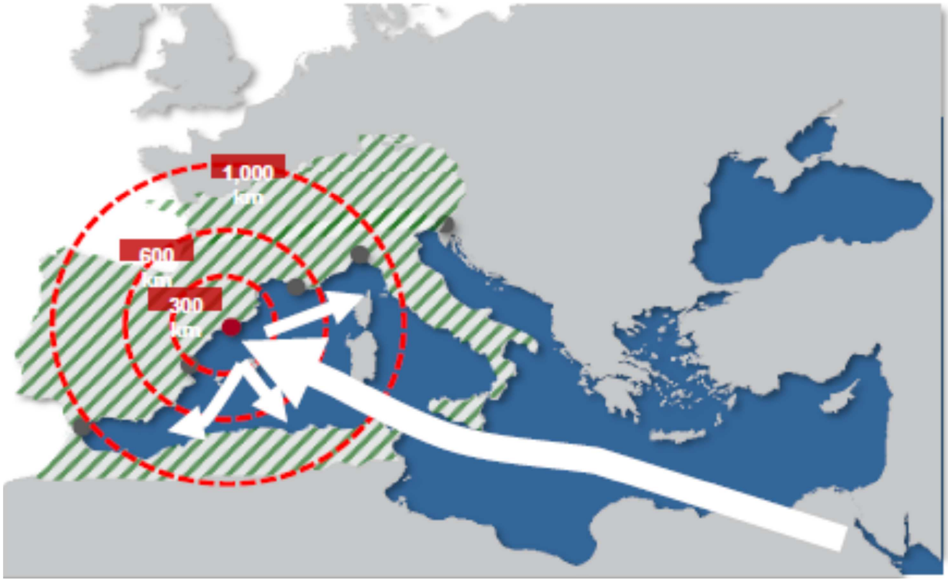


Figure 10. Barcelona as a gateway port. Proximity to main industrial, logistics and consumption centres in Europe (*source: own-source*)

The total maritime transport of goods from Barcelona, as it is shown in Figure 11, has been slowly decreasing since 2008 due to the economic crisis, with the major downfall in 2009 when the millions of tonnes of goods transported from Barcelona decreased from 41,5 to 35,9. However, this decrease is due to the decrease of the imports, as the exports have experienced an increase from 12,8 million tonnes in 2009 to 15,5 million tonnes in 2012.

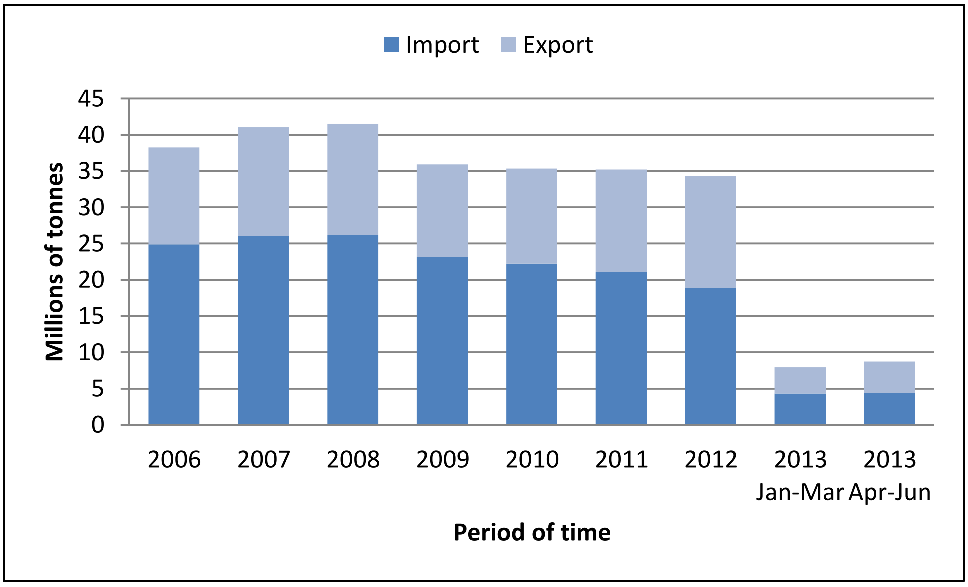


Figure 11. Total maritime transport of goods from Barcelona (*source: own-source using Eurostat data*)

As for the particular case of the maritime transport of goods from Barcelona with mainland China, the positive tendency also changed drastically in 2009, when the amount of goods transported dropped from 2,7 to 1,9 millions of tonnes in less than one year. However, in this case in 2010 and 2011 there was an increase of the maritime commerce between the two partners. In 2012 it decreased again. Nevertheless, the exports from Barcelona to mainland China have kept increasing since the downfall of 2009 from 462 thousands of tonnes that year to 592 thousands of tonnes in 2012, reaching the same top values as before the crisis.

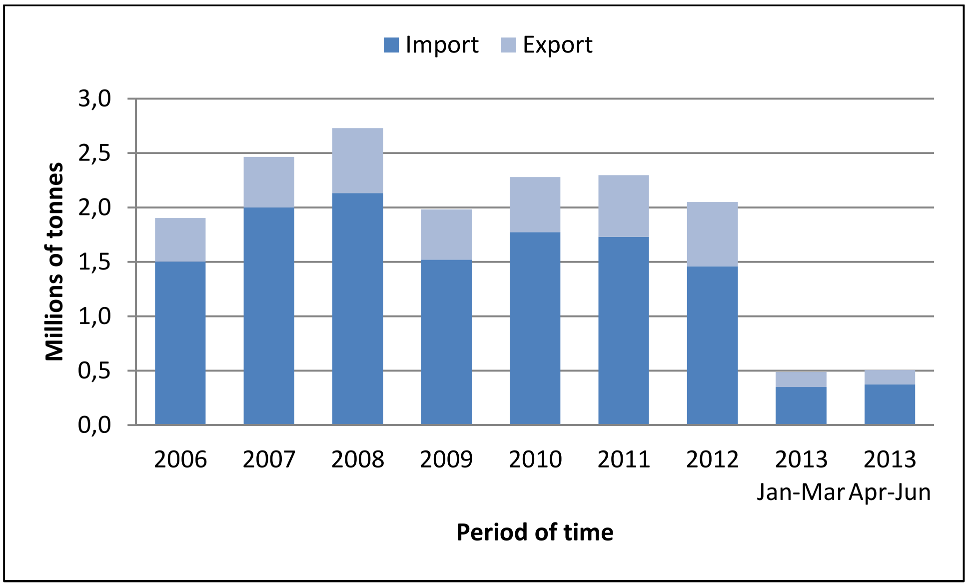


Figure 12. Total maritime transport of goods from Barcelona with mainland China (*source: own-source using Eurostat data*)

Mainland China represents a significant part of the maritime import and export of goods from Barcelona, as it can be seen in Figure 13 and Figure 14. However, the important role of mainland China as a maritime trade partner of Barcelona is concerning the maritime transport of large containers, that is to say, when we exclude from the analysis the shipping of dry and liquid bulk goods, Ro-Ro units and other types of cargo.

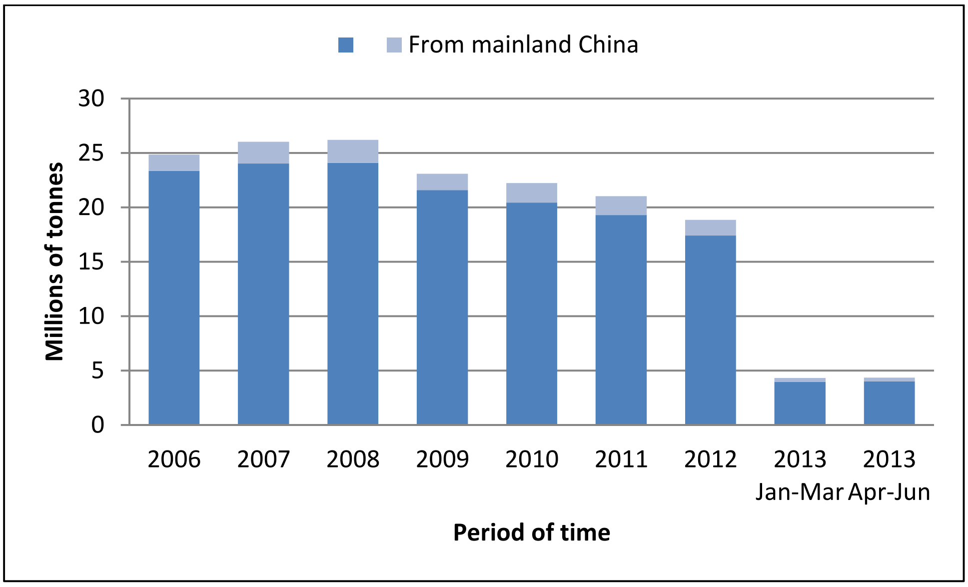


Figure 13. Maritime import of goods from Barcelona (*source: own-source using Eurostat data*)

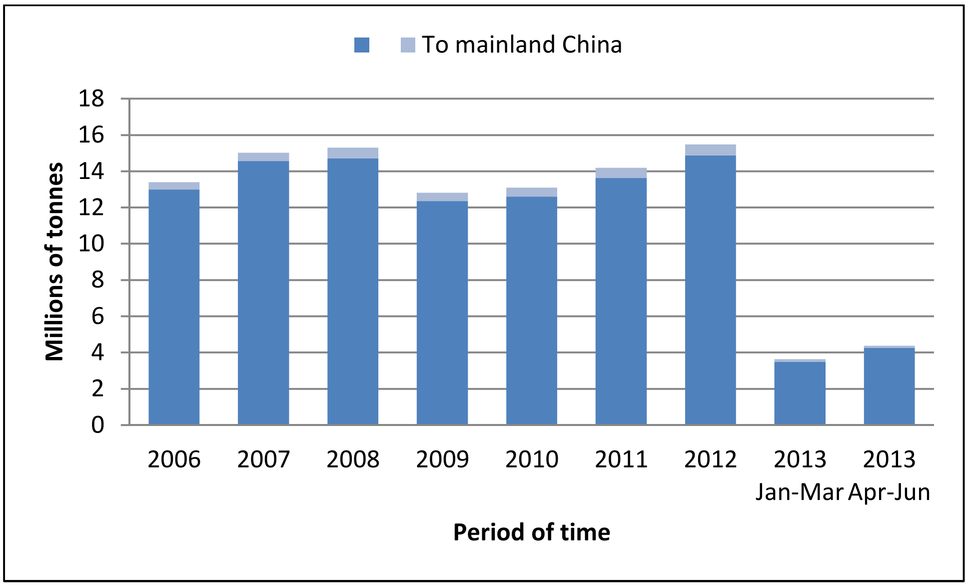


Figure 14. Maritime export of goods from Barcelona (*source: own-source using Eurostat data*)

Concerning the type of cargo transported from Barcelona, there are big differences concerning the imports and exports. While liquid bulk goods appear to be the largest type of cargo imported from Barcelona, followed by large containers, dry bulk goods and, in smaller quantities, Ro-Ro and other cargo not elsewhere specified; large containers are undoubtedly the largest type of cargo exported from the capital of Catalonia, followed by Ro-Ro – both mobile self and non-self-propelled units. In the export case, dry and liquid bulk goods do not play an important role in terms of quantity transported. Figure 15 and Figure 16 show the importance of large containers both in the maritime imports and exports from Barcelona with the rest of the World.

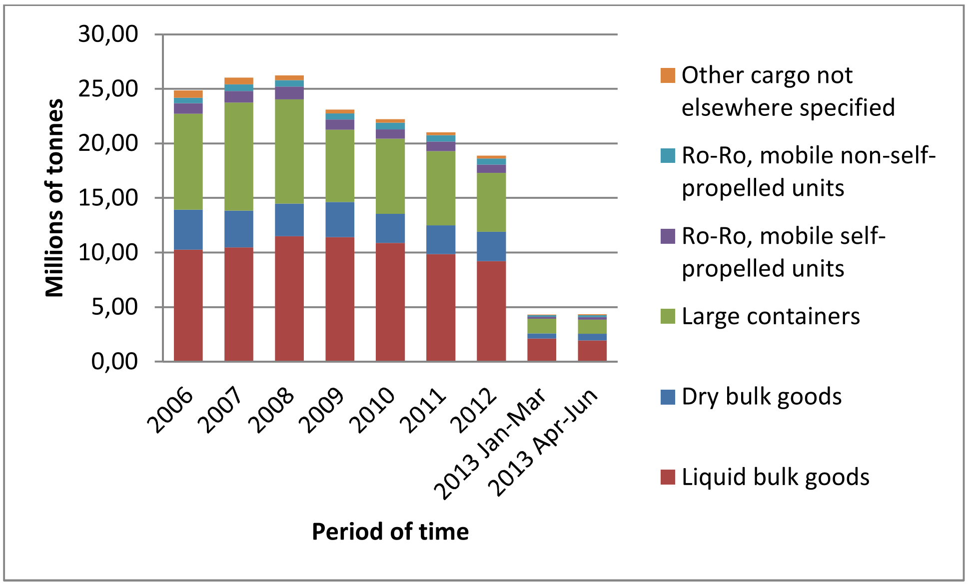


Figure 15. Type of cargo imported from Barcelona (*source: own-source using Eurostat data*)

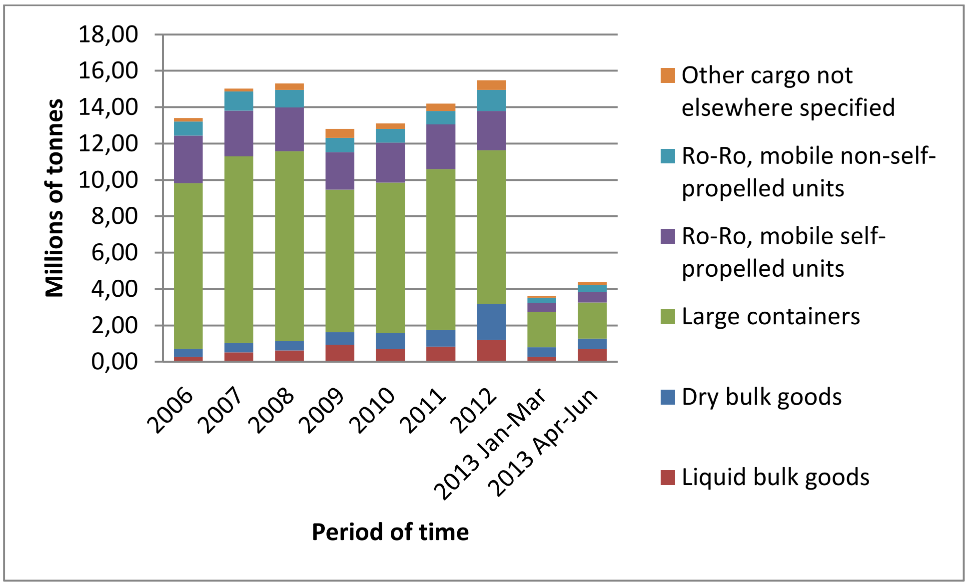


Figure 16. Type of cargo exported from Barcelona (*source: own-source using Eurostat data*)

However, when considering the particular case of mainland China as a maritime trade partner, the type of cargo both imported and exported from Barcelona is basically large containers. This shows why it makes sense to carry out the analysis of the maritime trade of goods from mainland China to Barcelona only in large containers measured in TEU.

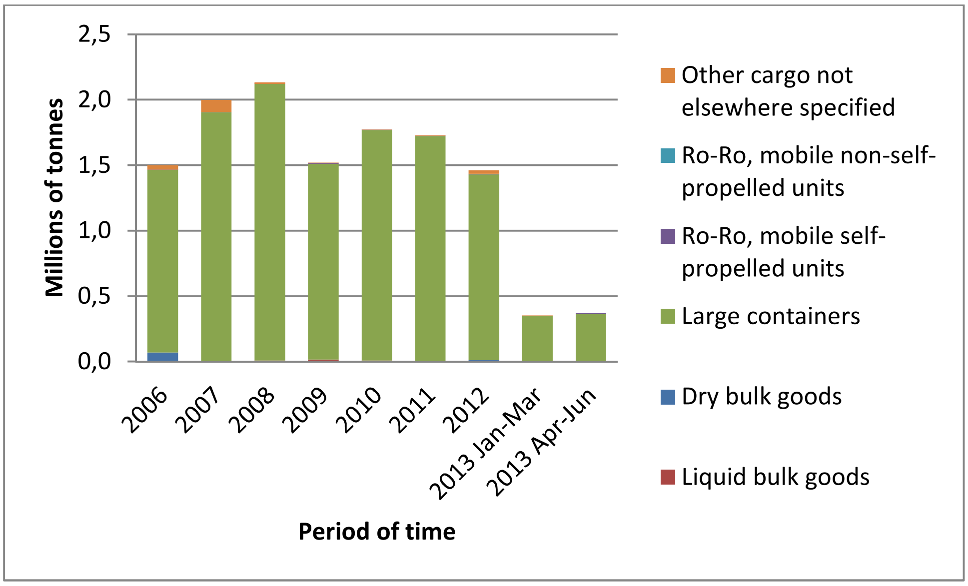


Figure 17. Type of cargo imported from Barcelona coming from mainland China (*source: own-source using Eurostat data*)

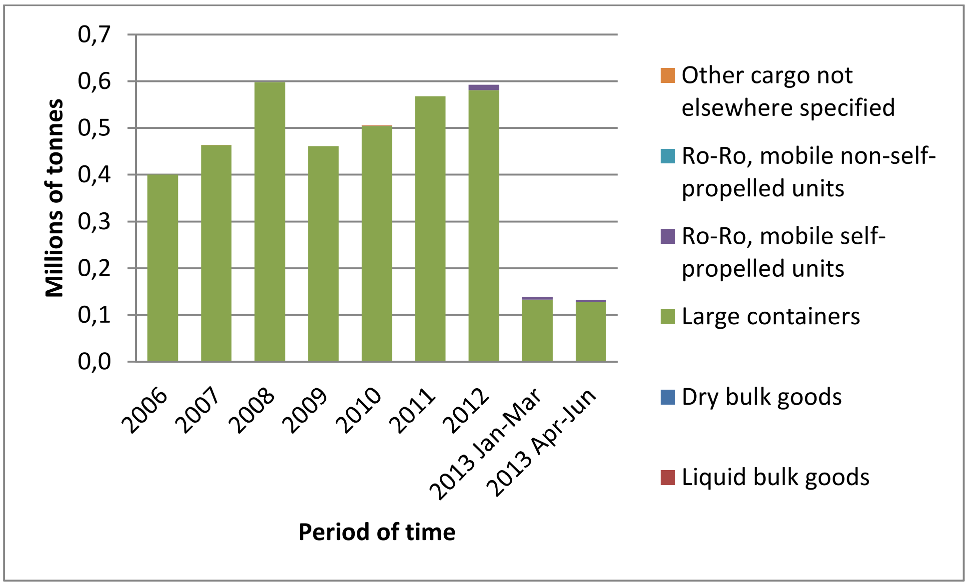


Figure 18. Type of cargo exported from Barcelona to mainland China (*source: own-source using Eurostat data*)

Until now the quantities transported to and from Barcelona have been analyzed, as well as what is the type of cargo for each case. The following lines will be focused on who is in charge of the transport of these goods.

Figure 19 shows the influence of Chinese registered vessels in the total maritime transport of large containers from Barcelona, while Figure 21 shows the same influence when the commercial partner of Barcelona is mainland China. Obviously, when the traffic of large containers is between Barcelona and mainland China, the influence of the Chinese registered vessels in the total maritime transport is larger than when the traffic is between Barcelona and anywhere else. In both cases the percentage of usage of Chinese registered vessels is lower than 6%, and it does not show a monotonous tendency with time. Although it seemed that from 2007 the influence of Chinese registered vessels was decreasing significantly until having almost no presence in 2010, in 2011 they have increased again their presence.

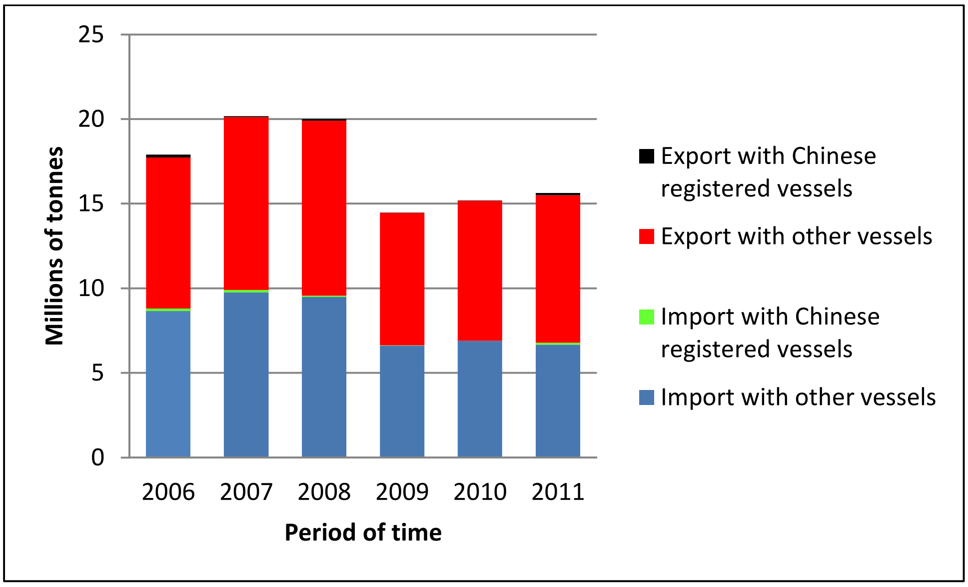


Figure 19. Influence of Chinese registered vessels in the total maritime transport of large containers from Barcelona (*source: own-source using Eurostat data*)

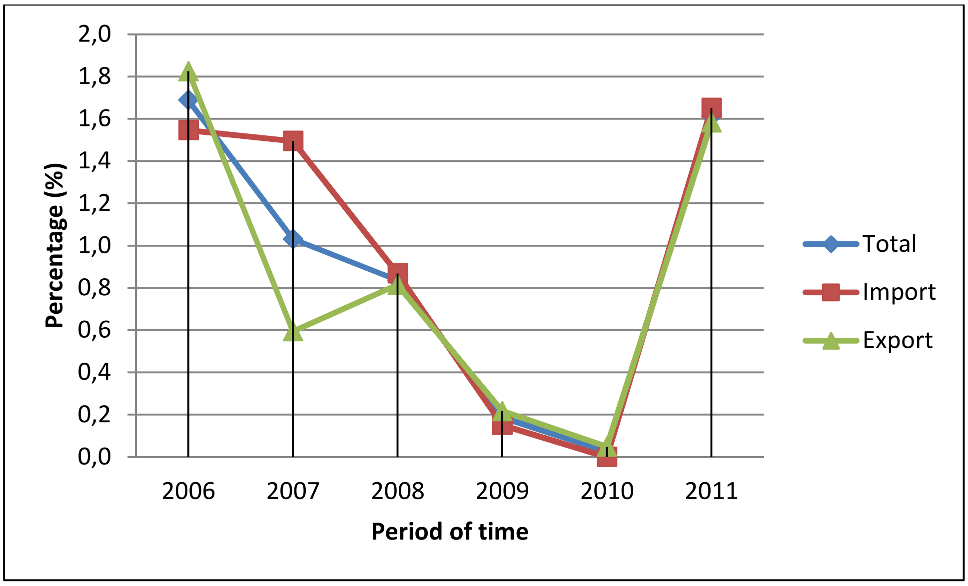


Figure 20. Percentage of usage of Chinese registered vessels in the total maritime transport of large containers from Barcelona (*source: own-source using Eurostat data*)

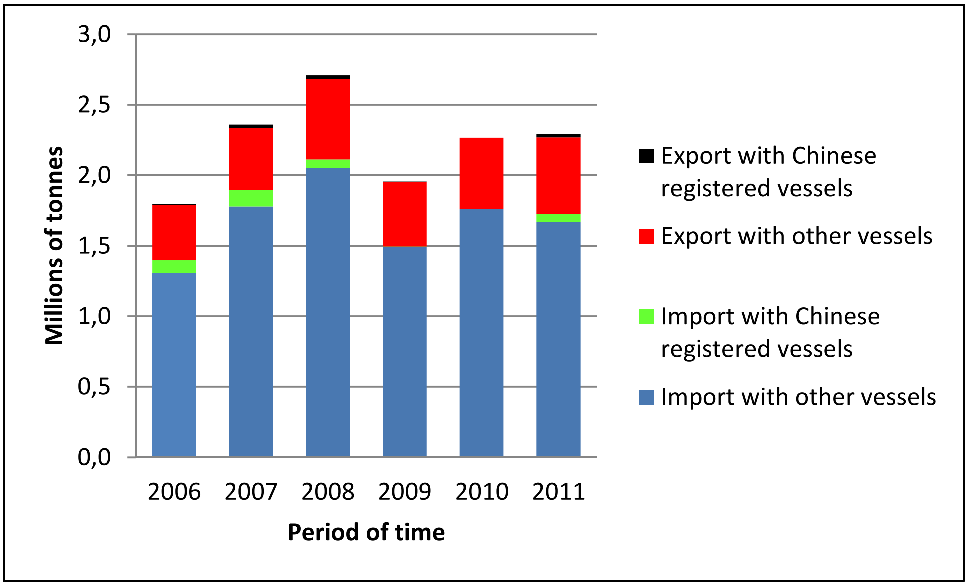


Figure 21. Influence of Chinese registered vessels in the total maritime transport of large containers from Barcelona with mainland China (*source: own-source using Eurostat data*)

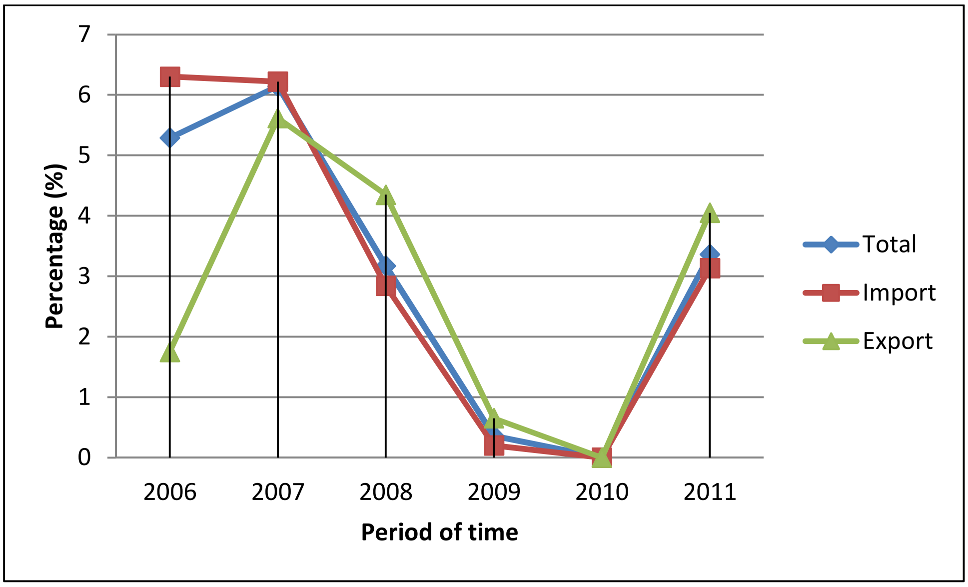


Figure 22. Percentage of usage of Chinese registered vessels in the total maritime transport of large containers from Barcelona with mainland China (*source: own-source using Eurostat data*)

From now on, the description of the maritime transport of goods between mainland China and Barcelona will be in terms of large containers measured in TEU. The Twenty-foot Equivalent Unit (TEU) is an inexact unit of cargo capacity often used to describe the capacity of container ships and container terminals. It is based on the volume of a 20-foot-long (6,1 m) intermodal container, a standard-sized metal box which can be easily transferred between different modes of transportation, such as ships, trains and trucks. There is a lack of standardisation in regards to height, ranging between 1,30 m and 2,90 m, with the most common height being 2,59 m.

The quarterly evolution of the total maritime transport, the total maritime import and the total maritime export of both loaded and empty TEU from Barcelona from the year 2000 until the second semester of 2013 are shown in Figure 23, Figure 24 and Figure 25, respectively. In the three cases there was a significant downfall after 2008 due to the European economic crisis, which has been followed by a slightly increase of the transport of TEU in 2010. In addition, it can be clearly seen that the influence of mainland China in the transport of TEU from Barcelona has increased significantly since 2000, both in the imports and the exports sides.

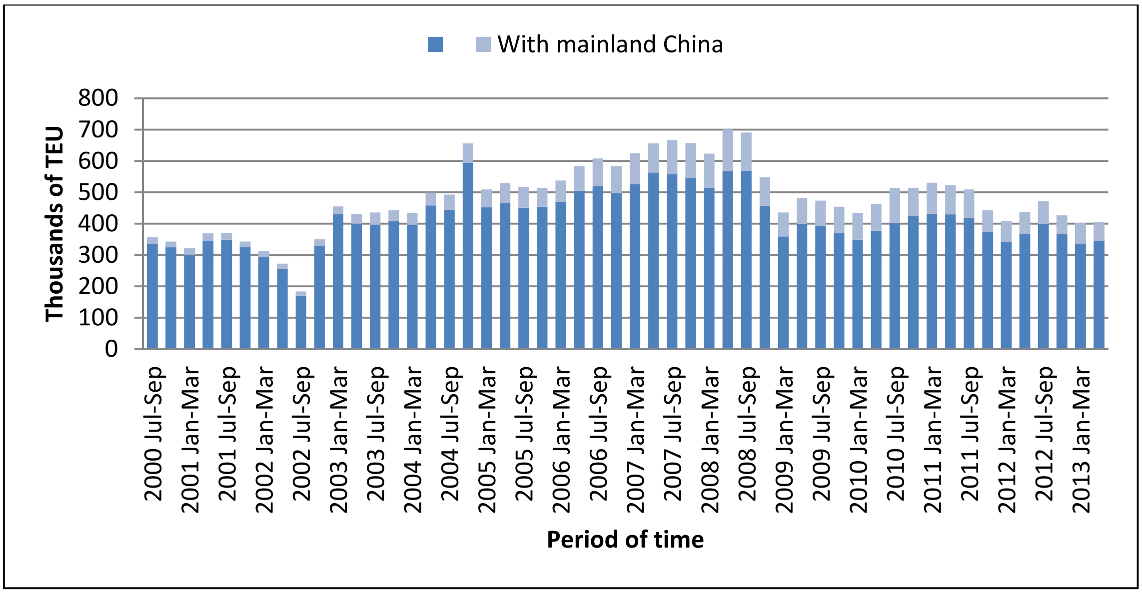


Figure 23. Total maritime transport of both loaded and empty TEU from Barcelona (*source: own-source using Eurostat data*)

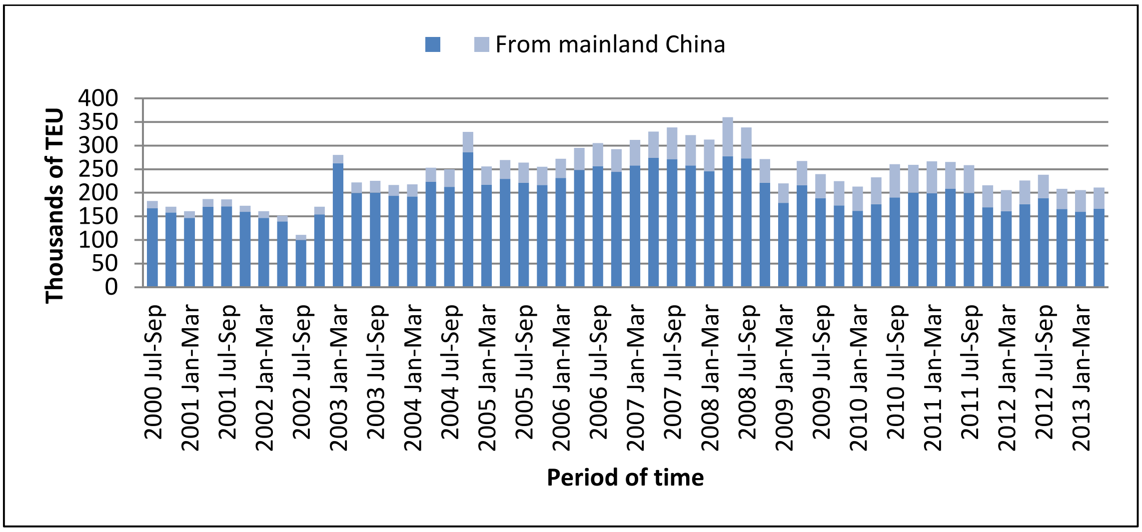


Figure 24. Total maritime import of both loaded and empty TEU from Barcelona (*source: own-source using Eurostat data*)

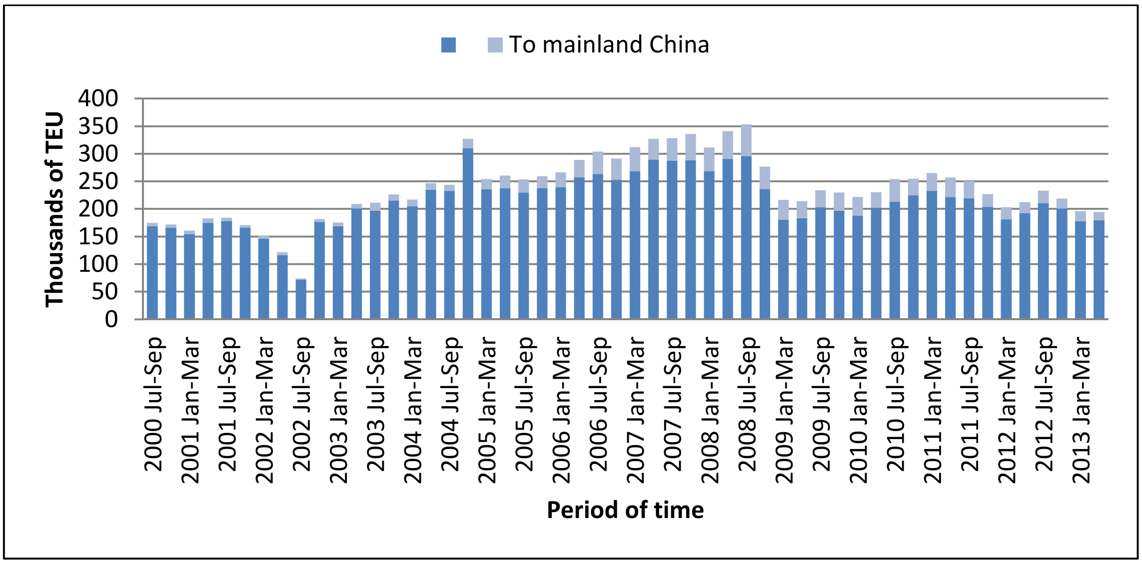


Figure 25. Total maritime export of both loaded and empty TEU from Barcelona (*source: own-source using Eurostat data*)

The quarterly evolution of the percentage of the total maritime transport, the total maritime import and the total maritime export of both loaded and empty TEU from Barcelona with respect to Spain from the year 2000 until the second semester of 2013 are shown in Figure 26, Figure 27 and Figure 28, respectively. Although Barcelona represents one of the biggest contributions to the total maritime transport of both loaded and empty TEU from Spain, its influence has been reduced significantly during the last years, both in the imports and exports. This may be due to the increasing competence of other Spanish ports, such as Valencia and Algeciras, which are specially increasing their competition in the Chinese market.

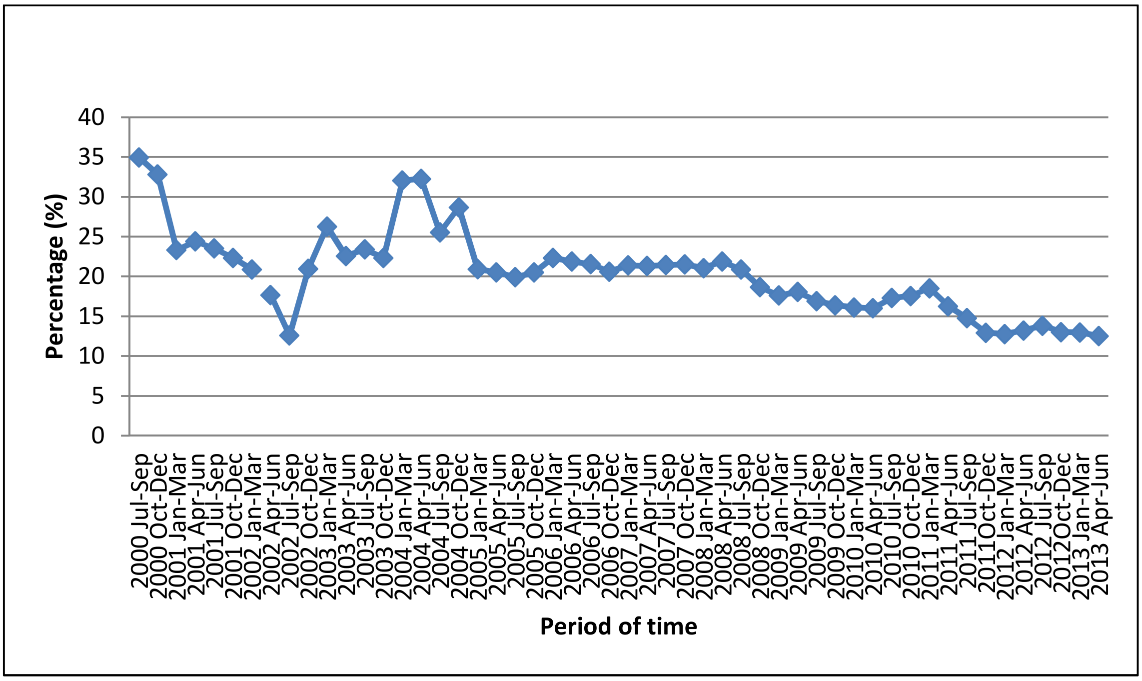


Figure 26. Percentage of the total maritime transport of both loaded and empty TEU from Barcelona with respect to Spain (*source: own-source using Eurostat data*)

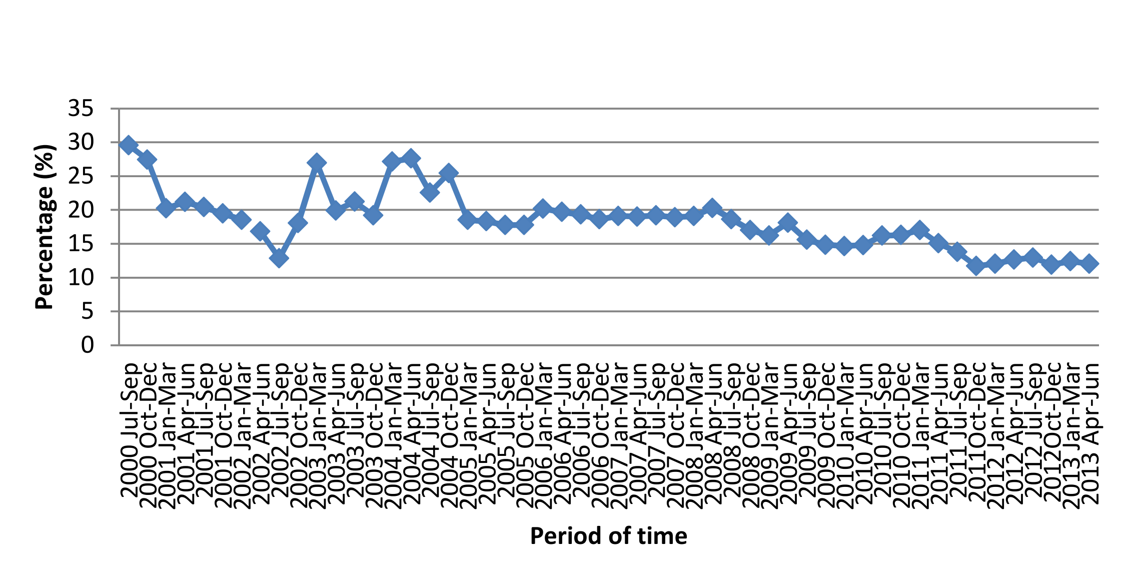


Figure 27. Percentage of the total maritime import of both loaded and empty TEU from Barcelona with respect to Spain (*source: own-source using Eurostat data*)

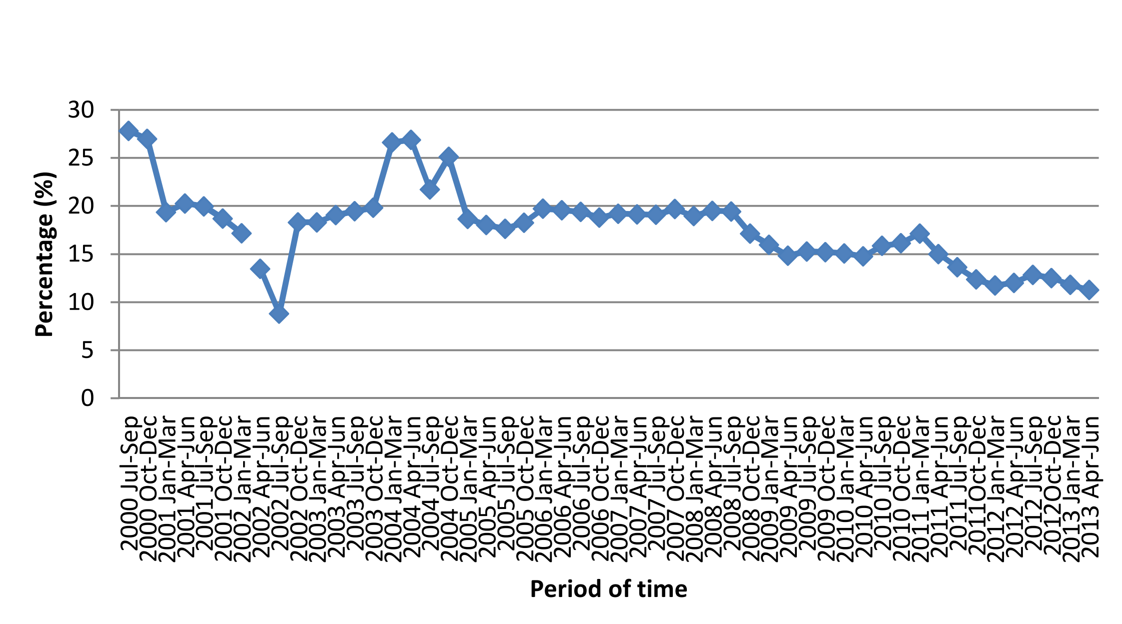


Figure 28. Percentage of the total maritime export of both loaded and empty TEU from Barcelona with respect to Spain (*source: own-source using Eurostat data*)

The quarterly evolution of the percentage of the total maritime transport, the total maritime import and the total maritime export of TEU from Barcelona with mainland China and with respect to Spain from the year 2000 until the second semester of 2013 are shown in Figure 29, Figure 30 and Figure 31, respectively. It can be seen that the influence of Barcelona in the transport of TEU between Spain and mainland China has decreased in the last decade. However, Barcelona is still playing a crucial role in this field. As before, its influence may have been reduced due to the emerging ports such as Valencia and Algeciras, which are also in the Mediterranean coast of Spain and are potential captors of the trade of TEU from mainland China via Suez.

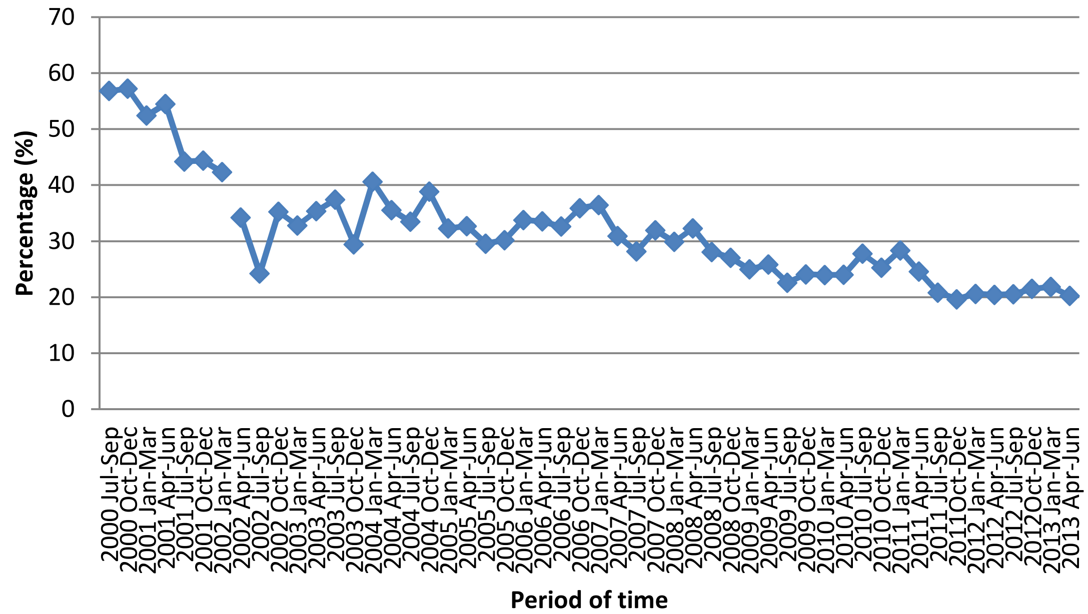


Figure 29. Percentage of the total maritime transport of both loaded and empty TEU from Barcelona with mainland China with respect to Spain (*source: own-source using Eurostat data*)

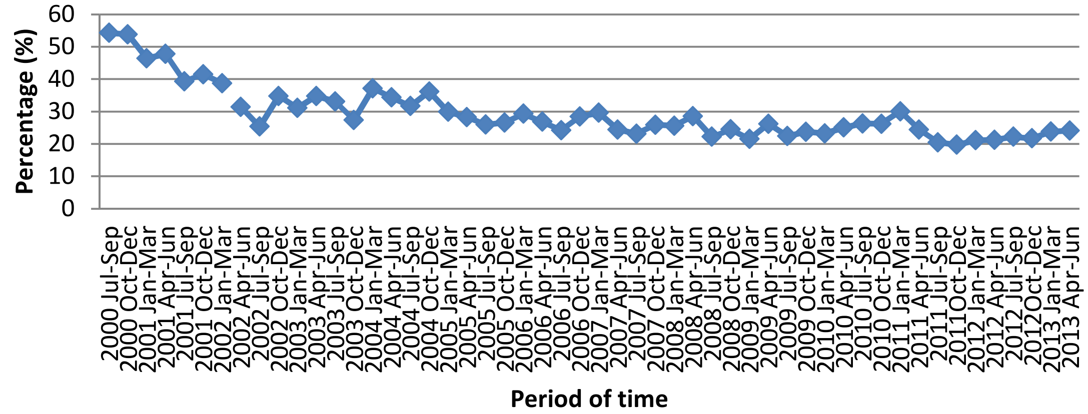


Figure 30. Percentage of the total maritime import of both loaded and empty TEU from Barcelona with mainland China with respect to Spain (*source: own-source using Eurostat data*)

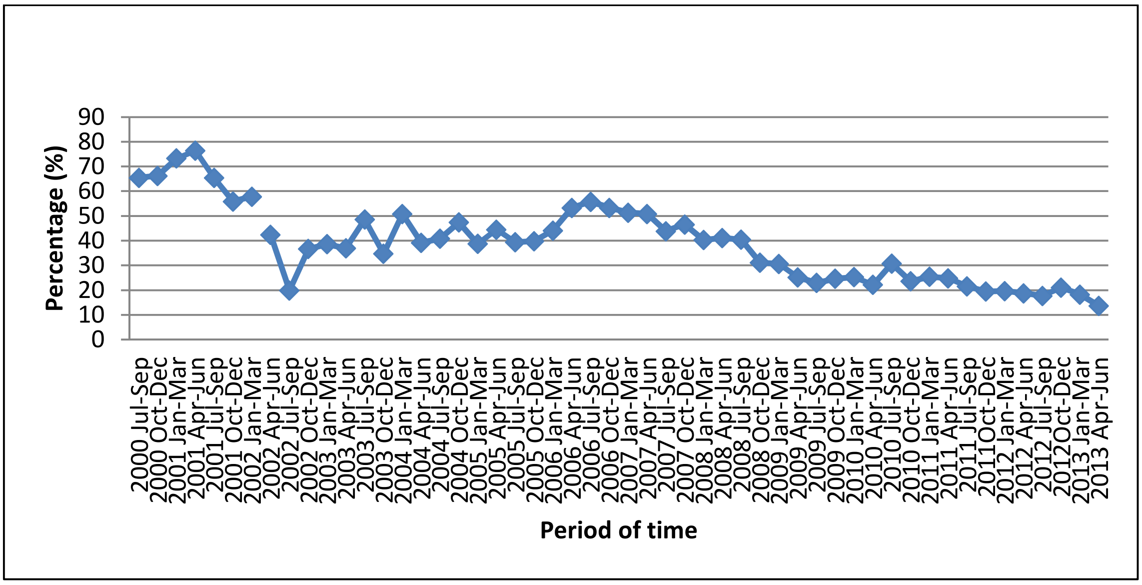


Figure 31. Percentage of the total maritime export of both loaded and empty TEU from Barcelona with mainland China with respect to Spain (*source: own-source using Eurostat data*)

As said before, an analysis of the maritime transport and distribution systems on the China-Europe trade-lane has been carried out. Containers coming from China typically arrive in Europe via Suez on large, dedicated container vessels. To maximise the benefits of scale, the number of port calls are relatively low and concentrated at the beginning and end of the rotation. Single origin-destination routes are not very common, because shipping lines operate hub and spoke networks rather than point to point services. The analysis therefore needs to be systems-based rather than case-based.

The data has been extracted from Eurostat, a Directorate-General of the European Commission located in Luxembourg. Its main responsibilities are to provide statistical information to the institutions of the European Union (EU) and to promote the harmonisation of statistical methods across its member states and candidates for accession as well as EFTA countries. One of the main areas of statistical activities is transport, including maritime, road, railway, air, inland waterways and oil pipeline transport. For the purpose of this research, only maritime transport statistics have been considered.

But in this analysis not only the traffic between mainland China and Barcelona is taken into account, also the transhipment occurring after this traffic. This means that, for example, a container which comes from China, either can be unloaded in Barcelona and be distributed through the hinterland via road or rail, or can be loaded into another ship for a Short Sea Shipping or a transoceanic service.

Thanks to the Port Authority of Barcelona, real statistics in this area have been found and summarised into the following tables. As said before, the rate of empty TEU transported to and from Barcelona has been taken into account, as a way of measuring the real movement of goods from the Port:

Table 5. Number of both loaded and empty TEU transported from Barcelona (*source: own-source using Port Authority of Barcelona data*)

	2006	2007	2008	2009	2010	2011	2012	**2013**
Total export	1.154.367	1.305.564	1.284.314	896.060	976.596	1.020.039	873.900	**849.182**
Export in transit	411.664	457.068	460.525	266.195	278.898	278.440	170.615	**128.794**
Total import	1.168.599	1.305.265	1.285.168	903.542	971.895	1.014.657	884.749	**869.223**
Import in transit	425.420	492.425	498.699	333.369	361.279	391.822	271.986	**150.656**

Table 6. Number of loaded TEU transported from Barcelona (*source: own-source using Port Authority of Barcelona data*)

	2006	2007	2008	2009	2010	2011	2012	**2013**
Total export	865.931	956.676	963.164	700.601	780.588	821.294	762.997	**770.903**
Export in transit	353.849	401.229	412.233	235.019	247.545	229.935	137.378	**117.483**
Total import	876.559	983.424	946.172	628.963	707.460	684.103	539.588	**523.765**
Import in transit	352.855	403.499	412.845	233.027	251.401	225.911	138.910	**116.486**

Table 7. Percentage of empty TEU with respect to the total number of TEU transported from Barcelona (*source: own-source using Port Authority of Barcelona data*)

	2006	2007	2008	2009	2010	2011	2012	**2013**
Total export	25	27	25	22	20	19	13	**9**
Export in transit	14	12	10	12	11	17	19	**9**
Total import	25	25	26	30	27	33	39	**40**
Import in transit	17	18	17	30	30	42	49	**23**

Table 8. Number of both loaded and empty TEU transported from Barcelona with mainland China (*source: own-source using Port Authority of Barcelona data*)

	2006	2007	2008	2009	2010	2011	2012	**2013**
Total export	136.554	171.209	191.114	130.182	135.017	125.828	84.162	**84.903**
Export in transit	10.942	19.670	33.594	8.342	8.890	14.798	7.285	**3.593**
Total	183.407	241.188	263.965	183.270	238.832	230.943	186.764	**186.309**

import								
Import in transit	11.211	39.185	68.696	27.998	50.486	45.736	34.174	**30.743**

Table 9. Number of loaded TEU transported from Barcelona with mainland China (*source: own-source using Port Authority of Barcelona data*)

	2006	2007	2008	2009	2010	2011	2012	**2013**
Total export	34.144	45.166	55.908	39.626	47.618	49.044	46.568	**46.743**
Export in transit	10.335	15.931	25.222	4.294	2.787	5.713	1.456	**2.099**
Total import	182.999	240.774	262.999	183.084	237.865	229.728	185.477	**185.291**
Import in transit	10.945	39.185	68.416	27.974	50.042	45.570	33.762	**30.741**

Table 10. Percentage of empty TEU with respect to the total number of TEU transported from Barcelona with mainland China (*source: own-source using Port Authority of Barcelona data*)

	2006	2007	2008	2009	2010	2011	2012	**2013**
Total export	75	74	71	70	65	61	45	**45**
Export in transit	6	19	25	49	69	61	80	**42**
Total import	0	0	0	0	0	1	1	**1**
Import in transit	2	0	0	0	1	0	1	**0**

The total movement of both loaded and empty TEU from Barcelona in 2013 was 1.718.404 TEU units, from which 869.223 were imported and 849.182 were exported. However, the real maritime transport of goods in containers from Barcelona is given by Table 6, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Barcelona in 2013 was 1.294.668 TEU units, from which 523.765 were imported and 770.903 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Barcelona is much higher in the imports (40%) than in the exports (9%). In other words, only a 9% of TEU exported from Barcelona in 2013 were empty, while a 40% of the imported ones were empty. These values have changed enormously in the past few years due to the economic recession. In 2006, the percentage of empty TEU with respect to the total number of TEU transported from was 25% both for imports and exports.

With mainland China the total movement of both loaded and empty TEU from Barcelona in 2013 was 271.212 TEU units, from which 186.309 were imported and 84.903 were exported. These data coincides with the data extracted from Eurostat. However, the real maritime transport of goods in containers between Barcelona and mainland China is given by Table 9, where the empty TEU transported from the Port with China are excluded. Therefore, the total movement of loaded TEU between Barcelona and mainland China in 2013 was 232.033 TEU units, from which 185.291 were imported and 46.743 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Barcelona with mainland China is now much higher in the exports (45%) than in the imports (1%). In other words, only a 1% of TEU imported from Barcelona coming from mainland China in 2013 were empty, while a 45% of the exported ones to China were empty. These values contrast with the previous ones of Barcelona with the rest of the World. They show that almost all the containers imported from Barcelona coming from mainland China are loaded, while a big percentage of the exported ones to mainland China are empty (45%). However, the percentage of empty TEU exported from Barcelona to mainland China has been decreasing in the past few years, showing that the importance of exports from Barcelona is increasing.

Moreover, Table 5, Table 6, Table 8 and Table 9 include information about the import in transit and export in transit TEU from Port of Barcelona. Export in transit refers to the containers that have their origin in another place, stop in Barcelona to load some more cargo and have another final destination. On the other side, import in transit refers to the containers that come from another place, unload in Barcelona and load into a new ship for a Short Sea Shipping or transoceanic service.

Concerning the total maritime export of both loaded and empty TEU from Barcelona, 128.794 out of 849.182 TEU are exported in transit from this port, which represents a 15% of the total. If we exclude from the analysis the empty TEU, 117.483 out of 770.903 loaded TEU are exported in transit from this port (15%). On the other side, concerning the total maritime import of both loaded and empty TEU from Barcelona, 150.656 out of 869.223 TEU are imported in transit from this port, which represents a 17% of the total. If we exclude from the analysis the empty TEU, 116.486 out of 523.765 loaded TEU are imported in transit from this port (22%).

Concerning the maritime export of both loaded and empty TEU from Barcelona with mainland China, only 3.593 out of 84.903 TEU are exported in transit from this port, which represents a 4% of the total. On the other side, concerning the maritime import of both loaded and empty TEU from Barcelona with mainland China, 30.743 out of 186.309 TEU are imported in transit from this port, which represents a 17% of the total. Thus, while the import in transit from Barcelona when the commercial partner is mainland China follows the pattern of the general import in transit from Barcelona, the exports in transit to mainland China are significantly lower than the total ones from Barcelona. If we exclude the empty TEU from the analysis and we focus on the loaded TEU, the percentage of transhipment both for imports and exports from Barcelona are similar to the ones here obtained.

For this analysis we are also interested in the final destination of the imports in transit from Barcelona coming from mainland China. By doing this with Port of Barcelona and the main

European Ports, a map of the current situation in the imports from Europe coming from mainland China can be built, from which the role of hub and spoke of each Port can be determined. As the percentage of empty TEU with respect to the total number of TEU imported from Barcelona coming from mainland China is very small (1%), it is irrelevant to differentiate between the two cases.

Therefore, the final destination of both loaded and empty TEU imported from Barcelona coming from mainland China are compiled in Table 11. As it can be seen, 28.405 out of the 30.743 TEU imported in transit from Barcelona coming from mainland China have Argelia as a final destination. The other main destinations of these imported in transit containers are Morocco (1.213), other ports of Spain (651), Guadalupe (201) and Martinica (147).The rest of the countries receive an insignificant proportion compared to these ones.

Table 11. Number of TEU imported from Barcelona with mainland China and transhipped to another destination (*source: own-source using Port Authority of Barcelona data*)

Final destination	2006	2007	2008	2009	2010	2011	2012	2013
Andorra	0	0	2	0	0	0	0	**0**
Belgium	2	3	1	0	0	1	2	**5**
Switzerland	0	2	0	0	0	0	0	**0**
Germany	2	15	9	0	4	0	0	**0**
Denmark	0	0	0	0	0	2	0	**0**
Estonia	1	0	0	0	0	0	0	**0**
Spain (Valencia)	2304	1966	1047,5	1172	2295,5	2245,5	52	**12,5**
Spain (Tarragona)	0	0	156	1	84	44	14	**0**
Spain	4351	9808,5	8710	4113,5	4708,5	2875	725	**650,5**
Finland	0	0	0	0	0	0	0	**0**
France	1273	4812,5	13835,5	1405	16752	12661,5	1198	**7**
UK	2	3	6	2	0	0	0	**0**
Italy	264	3933	8979,5	1298	4	30	343	**1**
Malta	0	2	4	7	10	5	36	**0**
Netherlands	0	100	6	2	0	0	2	**0**
Portugal	172	448	1802	382	815	527	52	**3**
Russia	0	0	0	0	0	93	0	**0**
Bulgaria	0	0	0	0	0	37,5	0	**0**
Serbia	0	1	0	0	0	0	0	**0**
Cyprus	0	0	0	0	0	10	0	**0**

Georgia	0	0	0	0	0	31	0	**0**
Greece	11	23	0	3	0	106,5	16	**0**
Croatia	0	0	19	0	2	0	0	**0**
Israel	1	2	0	0	0	92,5	0	**2**
Lebanon	0	13	0	0	0	16	0	**0**
Montenegro	0	0	0	0	2	1	0	**1**
Romania	0	0	0	0	0	33	0	**0**
Slovenia	0	1	0	0	1	4	0	**2**
Syria	0	2	1	1	1	30,5	0	**0**
Turkey	6	4	0	0	0	98	0	**0**
Ukraine	0	0	0	0	0	11	0	**2**
Benin	0	14	0	0	0	0	0	**0**
Costa Marfil d'Ivory	0	2	9	0	0	0	0	**0**
Camerun	0	80	0	0	0	0	6	**0**
Djibouti	0	0	0	0	0	0	0	**2**
Argelia	551	8563	16626	10746	17923,5	22286	27524	**28405**
Egypt	3	1	863	6	0	275	71	**32**
Ghana	2	25	21	0	0	0	0	**0**
Equatorial Guinea	0	0	0	0	0	0	0	**0**
Kenia	0	0	0	0	0	0	0	**1**
Lybia	0	0	0	0	2	0	0	**2,5**
Morocco	668	5946	11967	3148	2838	2207	762,5	**1214,5**
Nigeria	3	269	70	7	0	0	0	**0**
Senegal	3169	2809	3989	0	0	0	0	**0**
Togo	0	19	0	0	0	0	0	**0**
Tunez	6	688	564	1974	2292	297	490	**21**
South Africa	2	0	2	0	0	0	0	**0**
Arab Emirates	0	0	0	1	0	0	0	**0**
China	3	70	3	3	2	19	57	**19**
Hong Kong	0	0	2	0	0	5	3	**0**
India	0	0	0	0	0	0	0	**1**
Iran	0	19	19	0	2	0	0	**0**
Japan	0	0	0	0	0	0	0	**1**
South Korea	0	0	0	0	0	0	1	**0**
Malaysia	0	1	0	0	1	0	0	**0**
Saudi Arabia	0	0	0	0	0	0	1	**0**
Thailand	0	0	0	0	0	0	0	**1**

Vietnam	0	0	0	0	0	0	0	**4**
Asia (total)	3	90	24	4	5	24	62	**26**
Dutch Antilles	0	0	0	0	2	0	0	**0**
Argentina	0	174	2	292	48	61	2	**0**
Aruba	2	0	0	0	0	0	0	**0**
Brazil	326	927	883	4243	4403	3720	1088	**2**
Belize	6	0	0	0	0	0	0	**0**
Canada	27	1	56	1	0	0	0	**0**
Chile	0	2	0	0	0	0	0	**0**
Colombia	0	2	0	0	1	0	0	**0**
Cuba	0	0	0	19	20	0	0	**8**
Dominican Republic	9	3	5	4	40	0	0	**0**
French Guyana	0	0	0	0	0	0	1	**0**
Guadalupe	0	1	1	4	56	11	755	**201**
Guyana	6	0	0	0	0	0	0	**0**
Jamaica	14	0	0	0	0	0	0	**0**
San Cristobal y Nieves	0	0	0	0	0	0	0	**2**
Martinica	0	0	0	17	41	17	657	**147**
Mexico	0	1	0	0	0	0	0	**0**
Puerto Rico	0	0	0	0	0	0	0	**0**
Paraguay	0	305	0	279	59	21	0	**0**
Surinam	2	0	0	0	0	0	0	**0**
Trinidad and Tobago	6	0	0	0	0	0	0	**0**
USA	0	4	59	0	7	0	0	**2**
Uruguay	0	84	0	36	0	11	85	**3**
San Vicente	2	0	0	0	0	0	0	**0**
Venezuela	53	2	0	0	8	0	0	**0**
Australia	0	0	0	0	0	2	0	**0**
Marshall Islands	0	0	0	0	1	0	0	**0**
Others	266	0	180	4	440	138	296	**0**
Total	**11211**	**39185**	**68696**	**27997,5**	**50486**	**45735,5**	**34173,5**	**30742,5**

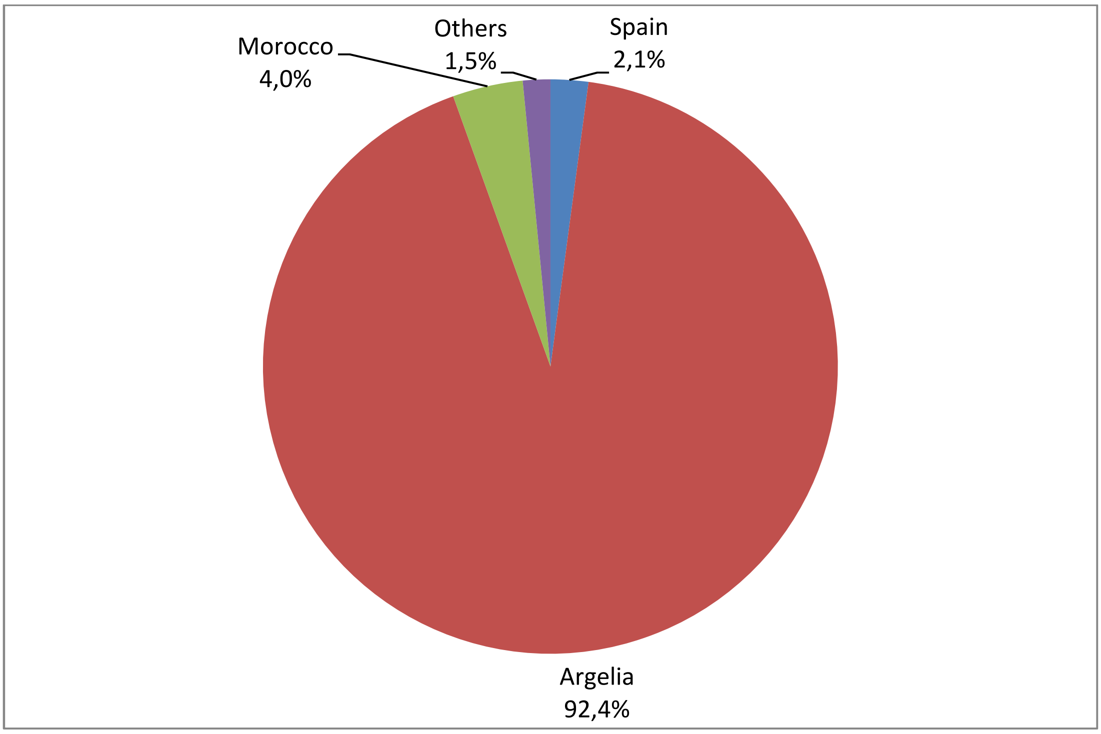


Figure 32. Main final destinations of TEU imported from Barcelona coming from mainland China and transhipped (*source: own-source using Port Authority of Barcelona data*)

It must be noted that these import and transit data refers to the place where the container crosses the border, and this in transit route is not necessarily done by ship. A prove of this is that in Table 11 there are some final destinations without ports (e.g. Andorra). Therefore, the number of TEU that are imported in transit to Andorra do not go by ship, but by road. However, the transhipment done with non-maritime areas by another mean of transport rather than by a container ship is insignificant, ensuring the quality of the analysis carried out.

From the information given in Table 5 to Table 10, it can be seen how the percentage of imports in transit from Barcelona was around 35% until 2010, when it started to decrease gradually until reaching 22% in the case of loaded TEU in 2013. If we consider the imports from Barcelona coming from mainland China, then the percentage of imports in transit has dropped from a 21% in 2010 to a 16% in 2013.

2.1.2. Algeciras

The Port of Algeciras is the port and harbour of Algeciras, a city located in the province of Cádiz, in the autonomous community of Andalusia, Spain. It is a commercial, fishing and passenger port. It consists of numerous maritime infrastructures scattered throughout the Bay of Gibraltar. Although only the town of Algeciras and La Línea de la Concepción overlook the bay, there are port facilities in the rest of the bank, also belonging to the municipalities of San Roque and Los Barrios. It is managed by the Port Authority of Algeciras Bay near the port of Tarifa.

It is the second Port of Spain and the Mediterranean Sea, and in 2004 was the 25th in the world container transport. In 2010 it exceeded 70 million tons in total traffic and more than 2.8 million containers. The port totals over 10 km of quays in different basins, which manage all types of passenger and freight traffic.

It is the 6th busiest container port in the continent of Europe and 39th in the World with a trade volume of 4,09 millions of TEU in 2012. It was the 3rd largest transhipment port in Europe and 10th in the World in 2004.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Algeciras from the year 2000 until the second semester of 2013 is shown in Figure 33, together with the influence of mainland China as its trade partner. There are some quarters without data available, such as in 2000 and 2004. Between 2005 and 2010 the amount of both loaded and empty TEU transported from Algeciras remained more or less constant at about 0,8 million per quarter, slightly decreasing in the last quarters of this period. From 2011 Algeciras increased its transport of TEU to more than one million quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of both loaded and empty TEU from Algeciras has increased significantly since 2000.

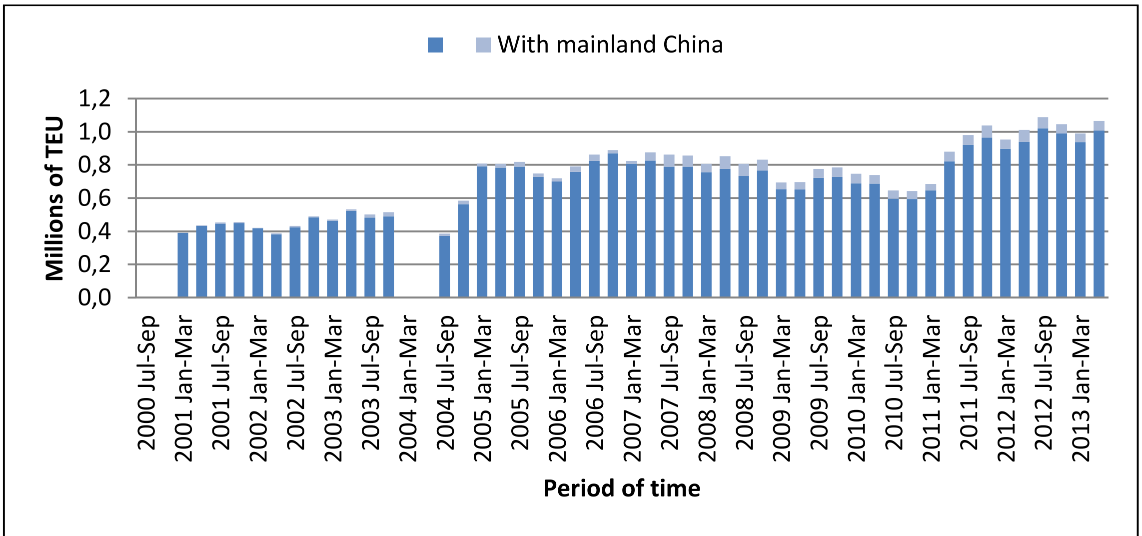


Figure 33. Total maritime transport of both loaded and empty TEU from Algeciras (*source: own-source using Eurostat data*)

As it was done for Barcelona, here not only the traffic between mainland China and Algeciras is taken into account, but also the transhipment occurring after this traffic. This means that, for example, a container which comes from mainland China, either can be unloaded in Algeciras and be directed to the hinterland via road or rail, or can be loaded into another ship for a Short Sea Shipping or a transoceanic service.

Thanks to Puertos del Estado, Ministerio de Fomento (Spain), real statistics in this area have been found and summarised into the following tables. The rate of empty TEU transported to and from Algeciras has been taken into account, as a way of measuring the real movement of goods from the Port. After discussing with the Port Authority of the Spanish Government, it has been declared that only the data after 2010 has validity for Port of Algeciras. Before 2010, data is wrong and cannot be considerate as representative for this port.

Table 12. Number of both loaded and empty TEU transported from Algeciras (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2010	2011	**2012**
Total export	1.369.291	1.780.752	**2.030.894**
Total import	1.407.571	1.803.132	**2.067.872**

Table 13. Number of loaded TEU transported from Algeciras (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2010	2011	**2012**
Total export	1.134.666	1.400.729	**1.659.269**
Total import	1.169.942	1.413.688	**1.631.754**

Table 14. Percentage of empty TEU with respect to the total number of TEU transported from Algeciras (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2010	2011	**2012**
Total export	17	21	**18**
Total import	17	22	**21**

Table 15. Number of both loaded and empty TEU transported from Algeciras with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2010	2011	**2012**
Total export	23.445	58.602	**91.189**
Total import	186.093	170.994	**159.126**
Import in transit (Port Authority data)	131.746	120.440	**138.746**
% import in transit (Port Authority data)	71	70	**87**

Table 16. Number of loaded TEU transported from Algeciras with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2010	2011	**2012**
Total export	14.416	43.898	**50.714**

Total import	185.951	169.386	**158.880**
Import in transit (same % as above table)	131.645	119.307	**138.531**

Table 17. Percentage of empty TEU with respect to the total number of TEU transported from Algeciras with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2010	2011	**2012**
Total export	39	25	**44**
Total import	0	1	**0**
Import in transit	0	1	**0**

The total movement of both loaded and empty TEU from Algeciras in 2012 was 4.098.766 TEU units, from which 2.067.872 were imported and 2.030.894 were exported. However, the real maritime transport of goods in containers from Algeciras is given by Table 13, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Algeciras in 2012 was 3.291.023 TEU units, from which 1.631.754 were imported and 1.659.269 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Algeciras is higher in the imports (21%) than in the exports (18%). In other words, an 18% of TEU exported from Algeciras in 2012 were empty, while a 21% of the imported ones were empty. These values have not changed significantly in the past few years.

With mainland China the total movement of both loaded and empty TEU from Algeciras was 250.315 TEU units, from which 159.126 were imported and 91.189 were exported. However, the real maritime transport of goods in containers from Algeciras with mainland China is given by Table 16, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Algeciras with mainland China in 2012 was 209.594 TEU units, from which 158.880 were imported and 50.714 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Algeciras with mainland China is now much higher in the exports (44%) than in the imports (0%). In other words, only 246 out of 159.126 TEU imported from Algeciras coming from mainland China in 2012 were empty, while a 44% of the exported ones to China were empty. These values contrast with the previous ones of Algeciras with the rest of the World. They show that almost all the containers imported from Algeciras coming from mainland China are loaded, while a big percentage of the exported ones to mainland China are empty (44%).

Table 15 and Table 16 include information about the import in transit of TEU from Port of Algeciras. As it is said before, import in transit refers to the containers that come from another place, unload in Algeciras and load into a new ship for a Short Sea Shipping or transoceanic service.

It can be seen that in 2012, 138.746 out of 159.126 both loaded and empty TEU were imported in transit from this port, which represents an 87% of the total. This percentage agrees with a research carried out by ITMMA, “Economic Analysis of the European Seaport System” (2009), where the rate of transhipment from Algeciras is fixed at 85%. However, it must be said that this percentage has increased since the previous years: 70% in 2010 and 71% in 2011. Port of Algeciras, therefore, has a much higher rate of transhipment than Barcelona (17%). This is probably due to the strategic position of Algeciras, in the south of Spain, which allows the Port to establish a lot of Short Sea Shipping routes with Africa. If we exclude the empty TEU from the analysis and we focus on the loaded TEU, the percentage of transhipment both for imports and exports from Algeciras is similar to these ones.

From all the sources of information checked, the data concerning the final destination of the imports in transit coming from China was not available. However, from Eurostat the export information from Algeciras in terms of TEU could be downloaded. Therefore, the principal commercial partners of the port were noticed. As the rate of transhipment of Algeciras is at 85%, means that the transport to and from the hinterland is only about 15%. This means that a good estimation for the final destination of the imports in transit from Algeciras can be done by analysing the destinations of the exports from Algeciras.

In addition, as the percentage of empty TEU with respect to the total number of TEU imported from Algeciras coming from mainland China is very small (0%), it is irrelevant to differentiate between the two cases.

Table 18. Destination of both loaded and empty TEU exported from Algeciras in 2012 (*source: own-source using Eurostat data*)

Destination	TEU exported in 2012 from Algeciras	%
Belgium	13.627	0,7
Germany	27.403	1,3
Spain	106.010	5,2
Italy	45.556	2,2
Malta	38.707	1,9
Netherlands	10.848	0,5
Portugal	48.588	2,4
United Kingdom	15.017	0,7
Turkey	66.196	3,3
United Arab Emirates	38.995	1,9
Angola	63.959	3,1

Argentina	21.810	1,1
Benin	41.278	2,0
Brazil	69.755	3,4
Congo	24.990	1,2
Côte d'Ivoire	36.639	1,8
Cameroon	41.058	2,0
China (except Hong Kong)	91.189	4,5
Colombia	13.902	0,7
Egypt	38.438	1,9
Ghana	106.554	5,2
Gambia, The	16.642	0,8
Guinea	31.232	1,5
Hong Kong	11.627	0,6
India	14.356	0,7
Liberia	25.657	1,3
Morocco	36.392	1,8
Mauritania	27.327	1,3
Malaysia	21.975	1,1
Nigeria	152.283	7,5
Panama	38.850	1,9
Saudi Arabia	30.890	1,5
Singapore	44.086	2,2
Sierra Leone	22.168	1,1
Senegal	45.737	2,3
Togo	23.803	1,2
United States	70.802	3,5
Others	456.548	22,5

The Asian countries of the list have been marked in red colour in order to separate them from the rest. It is obvious that a container that comes from mainland China will not be imported in transit from Algeciras and redirected to mainland China again. To simplify the analysis, these destinations have been added together by continents in the following Table 19. From this table it can be seen that the biggest part of the exports from Algeciras go to Africa (49%), while an important part goes to the rest of Europe (22%).

Table 19. Exports of both loaded and empty TEU from Algeciras in 2012 (*source: own-source*)

Destination	**%**
Europe	22,3

Africa	49,1
America	13,7
Others	15,0

Considering that we are only interested in the final destination of the imports in transit when the commercial partner is mainland China, it will be considered that a big part of these imports in transit (60%) have final destination Africa, one third of them Europe (30%), a little part of them America (7%) and the left 3% will have other destinations (Oceania, Asia).

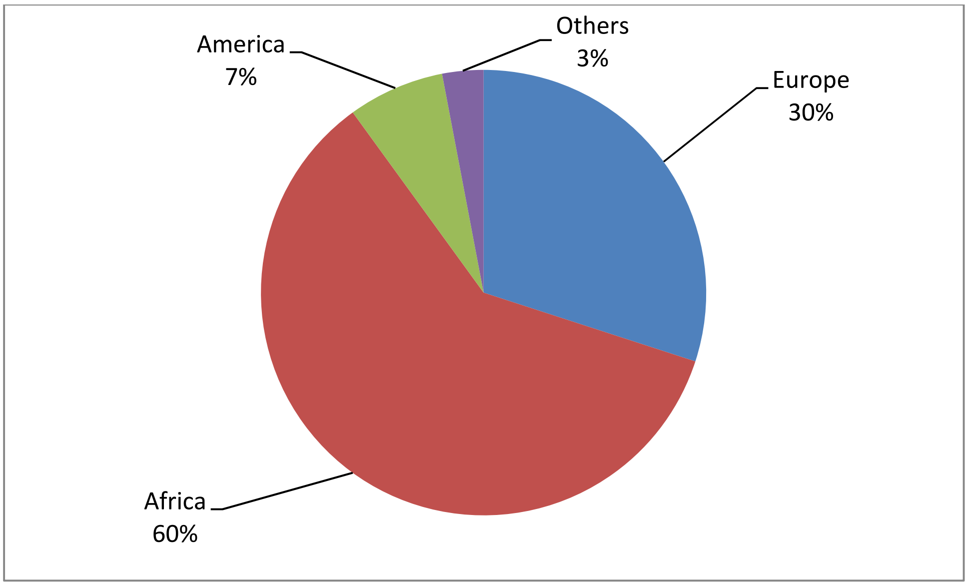


Figure 34. Main final destinations of both loaded and empty TEU imported from Algeciras coming from mainland China and transhipped (*source: own-source*)

Out of the 30% of Europe, the main final destinations of both loaded and empty TEU imported from Algeciras coming from mainland China have also been estimated. Spain represents the main final destination of transhipments, followed by Turkey (17%), Portugal (13%) and Italy (12%).

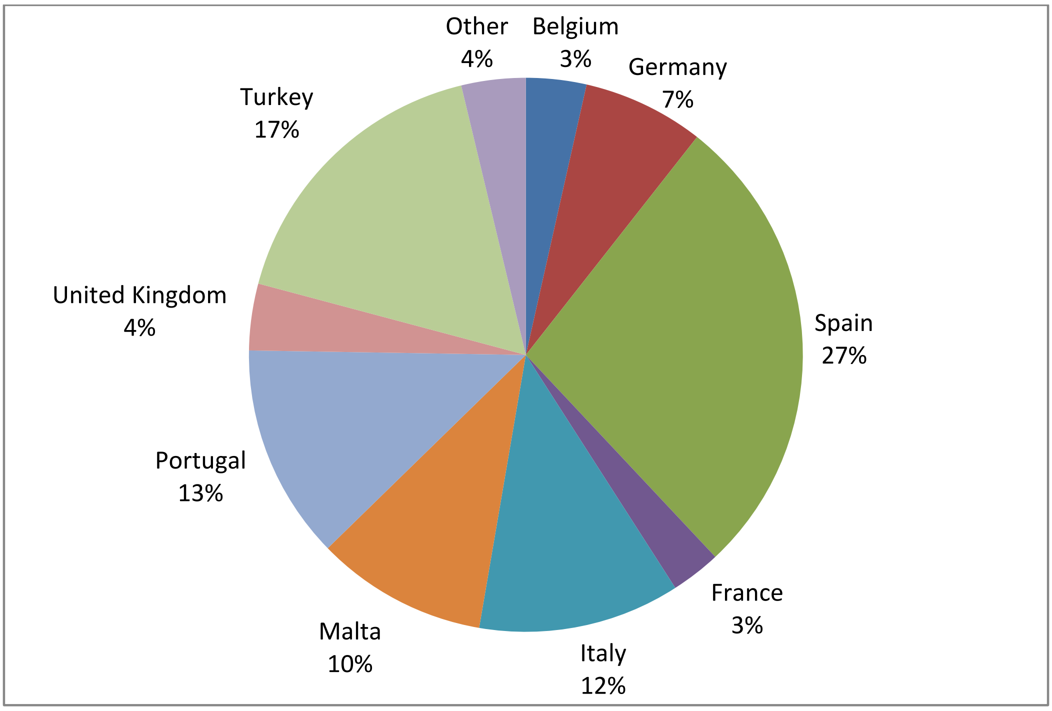


Figure 35. Main final destinations in Europe of both loaded and empty TEU imported from Algeciras coming from mainland China and transshipped (*source: own-source*)

2.1.3. Bilbao

The Port of Bilbao is located on the Bilbao Abra bay, and along the Estuary of Bilbao, in Biscay (Basque Country). The main facilities are in the Santurtzi and Zierbena municipalities, approximately 15 km west of Bilbao. The port complex occupies 3,13 km^2 of land and 16,94 km^2 of water along 17 km of waterfront.

The container volume was 609.996 TEU in year 2012. The Port is the 4th busiest port in Spain after Algeciras, Barcelona and Valencia, and is Spain's largest. From 1998 to the present, the port's physical capacity has increased dramatically, so this has influenced the increase of traffic in the last years.

The port is served by the RENFE railroad, but a new rail connection is needed because the current line is shared by commuter traffic and goes through a densely populated metropolitan area. A high speed connection is being considered, but Spain's current high-speed network does not support goods traffic.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Bilbao from the year 2000 until the second semester of 2013 is shown in Figure 36, together with the influence of mainland China as its trade partner. Between 2000 and 2004 the amount of both loaded and empty TEU transported from Bilbao remained constant at around 100 thousand TEU quarterly. From 2005 to 2008 it increased significantly to 230 thousand TEU quarterly, but from 2009 it dropped down drastically due to the economic crisis, remaining until 2013 stable at

150 thousand TEU quarterly. In addition, it can be observed that the influence of mainland China in the total maritime transport of TEU from Bilbao has not changed significantly during the last few years, actually it has slightly decreased after the starting of the European economic crisis in 2008.

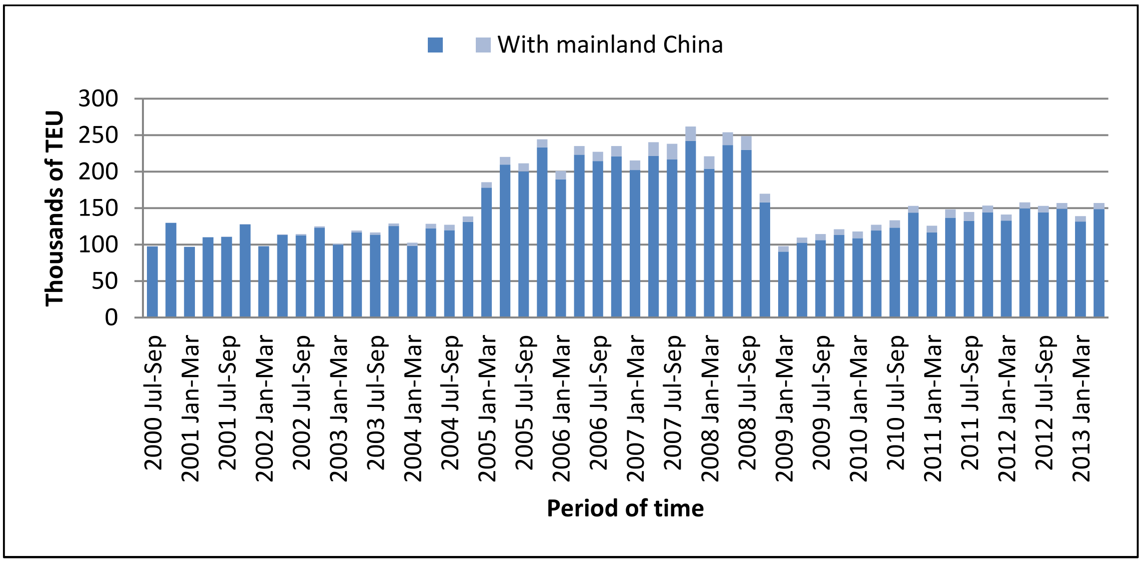


Figure 36. Total maritime transport of both loaded and empty TEU from Bilbao (*source: own-source using Eurostat data*)

Again, the total number of TEU transported from Bilbao and from Bilbao with mainland China is reported here. As for this specific study, also the imports in transit from Bilbao have been recorded thanks to the Port Authority of Bilbao and Puertos del Estado, Ministerio de Fomento (Spain). In the case of imports and imports in transit coming from mainland China, information from 2013 has been provided. The rate of empty TEU transported to and from Bilbao has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 20. Number of both loaded and empty TEU transported from Bilbao (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	441.147	455.450	484.253	452.053	228.812	272.546	292.906	**313.635**
Total import	421.724	443.220	471.861	442.341	214.652	259.455	279.841	**296.361**

Table 21. Number of loaded TEU transported from Bilbao (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	396.681	415.793	428.468	403.119	204.995	247.608	272.880	**297.711**

Total import	263.772	269.032	294.733	272.325	126.426	145.188	149.325	**141.359**

Table 22. Percentage of empty TEU with respect to the total number of TEU transported from Bilbao (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	10	9	12	11	10	9	7	**5**
Total import	37	39	38	38	41	44	47	**52**

Table 23. Number of both loaded and empty TEU transported from Bilbao with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**	**2013**
Total export	9.566	12.439	11.245	9.120	7.045	6.700	11.419	**6.651**	-
Total import	29.887	37.407	61.544	56.902	23.792	29.468	30.501	26.702	**26.634**
Import in transit (Port Authority data)	4	3	28	984	0	0	3	38	**163**
% import in transit (Port Authority data)	0	0	0	2	0	0	0	0	**1**

Table 24. Number of loaded TEU transported from Bilbao with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**	**2013**
Total export	9.347	12.435	11.245	9.120	7.035	6.699	11.419	**6.651**	-
Total import	29.886	37.407	61.544	56.899	23.792	29.468	30.501	26.580	**26.574**
Import in transit (same % as above table)	4	3	28	984	0	0	3	38	**163**

Table 25. Percentage of empty TEU with respect to the total number of TEU transported from Bilbao with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	2	0	0	0	0	0	0	0
Total import	0	0	0	0	0	0	0	0

The total movement of both loaded and empty TEU from Bilbao in 2012 was 609.996 TEU units, from which 296.361 were imported and 313.635 were exported. However, the real maritime transport of goods in containers from Bilbao is given by Table 21, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Bilbao in 2012 was 439.070 TEU units, from which 141.359 were imported and 297.711 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Bilbao is much higher in the imports (52%) than in the exports (5%). In other words, only a 5% of TEU exported from Bilbao in 2012 were empty, while a 52% of the imported ones were empty. While the percentages for exports has been kept constant during the last decade, the percentage of empty TEU for imports has been growing progressively from 37% in 2005 to 52% in 2012. The economic recession is a possible explanation to this fact.

With mainland China the total movement of both loaded and empty TEU from Bilbao in 2013 was 33.285 TEU units, from which 26.634 were imported and 6.651 were exported. However, the real maritime transport of goods in containers from Bilbao with mainland China is given by Table 24, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Bilbao with China in 2013 was 33.225 TEU units, from which 26.574 were imported and 6.651 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Bilbao with mainland China is 0% both for imports and for exports. These values contrast with the previous ones of Bilbao with the rest of the World. They show that almost all the containers imported or exported from Bilbao from/to mainland China are loaded.

Moreover, Table 23 and Table 24 include information about the imports in transit TEU from Port of Bilbao coming from mainland China. It can be seen that in 2013, only 163 out of 26.634 both loaded and empty TEU (163 out of 26.574 loaded TEU) were imported in transit from this port, which represents a 0,61% of the total. This insignificant percentage shows that almost all the containers imported from Bilbao coming from mainland China are directed to the hinterland, so there is no need to determine the final destination of them.

2.1.4. Valencia

The Port of Valencia is the fifth busiest seaport in Europe, being also the largest in Spain and in the Mediterranean Sea basin, with an annual traffic capacity of around 4.470.507 TEU in 2012. The port is also an important employer in the area, with more than 15,000 employees who provide services to more than 7,500 ships every year.

The three ports controlled by the Port Authority of Valencia are in Valencia, Sagunto and Gandía. They are located on the shores of the Mediterranean Sea, along an 80 km stretch of Spain's eastern coastline.

The Port of Valencia is the center of economic activity in an area of influence encompassing a radius of 350 km, which generates 51% of Spain's GDP and includes half the entire working population of the country. The port has a quay length of 12 km and a total storage area of 1,2 km^2.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Valencia from the year 2000 until the second semester of 2013 is shown in Figure 37, together with the influence of mainland China as its trade partner. In this 13 years period the amount of both loaded and empty TEU transported from Valencia has been gradually increasing from 0,3 million TEU per quarter until 1,1 million TEU quarterly. The European economic crisis starting in 2008 did not affect significantly the expansion of the Port of Valencia. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Valencia has increased significantly since 2000.

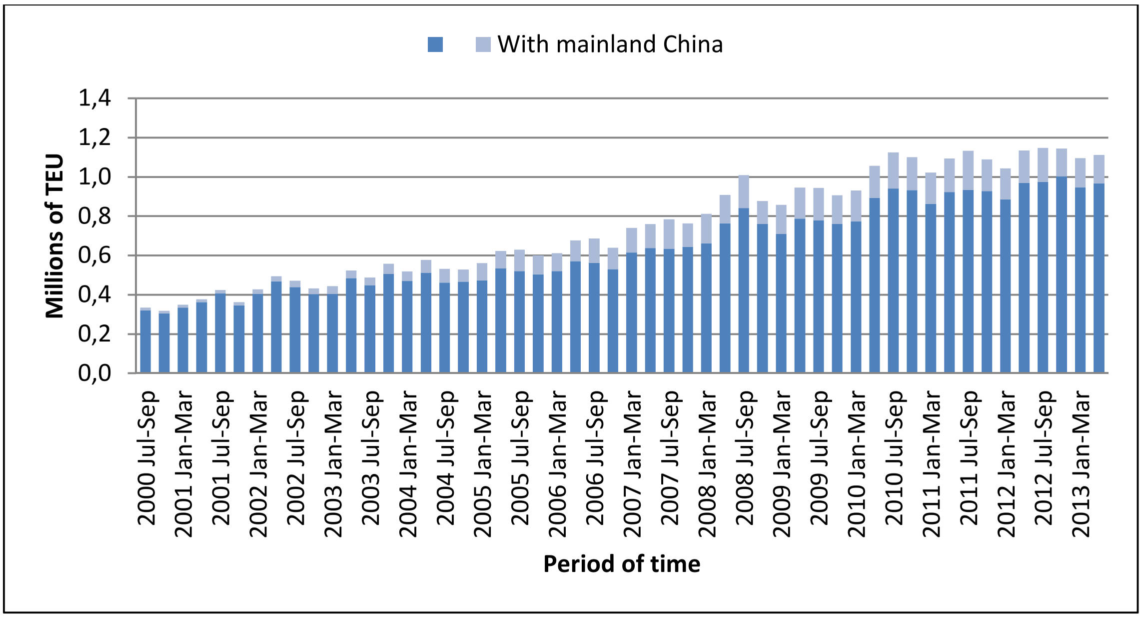


Figure 37. Total maritime transport of both loaded and empty TEU from Valencia (*source: own-source using Eurostat data*)

As for the previous analysed ports, the total number of TEU transported from Valencia and from Valencia with mainland China is reported here. As for this specific study, also the imports in transit from Valencia have been recorded thanks to Puertos del Estado, Ministerio de Fomento (Spain).

Table 26. Number of both loaded and empty TEU transported from Valencia (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	1.285.869	1.502.061	1.813.899	1.833.197	2.112.666	2.139.164	**2.243.962**
Total import	1.329.043	1.546.843	1.792.444	1.821.234	2.098.511	2.199.200	**2.226.545**

Table 27. Number of loaded TEU transported from Valencia (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	971.139	1.084.167	1.358.630	1.414.645	1.622.890	1.708.799	**1.794.918**
Total import	966.744	1.188.804	1.402.739	1.422.371	1.643.239	1.677.903	**1.619.698**

Table 28. Percentage of empty TEU with respect to the total number of TEU transported from Valencia (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	24	28	25	23	23	20	**20**
Total import	27	23	22	22	22	24	**27**

Table 29. Number of both loaded and empty TEU transported from Valencia with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	100.053	133.338	169.847	227.934	229.713	233.992	**216.317**
Total import	329.868	384.780	410.206	389.441	440.584	457.598	**420.379**
Import in transit (Port Authority data)	75.584	71.041	107.024	117.977	130.659	153.237	**160.528**
% import in transit (Port Authority data)	23	18	26	30	30	33	**38**

Table 30. Number of loaded TEU transported from Valencia with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	56.814	63.283	97.916	164.860	136.454	140.130	**134.453**
Total import	328.107	383.821	409.685	389.185	440.294	457.474	**420.026**
Import in transit (same % as above table)	75.180	70.864	106.888	117.900	130.573	153.195	**160.393**

Table 31. Percentage of empty TEU with respect to the total number of TEU transported from Valencia with mainland China (*source: own-source using Puertos del Estado, Ministerio de Fomento data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	43	53	42	28	41	40	**38**
Total import	1	0	0	0	0	0	**0**

The total movement of both loaded and empty TEU from Valencia in 2012 was 4.470.507 TEU units, from which 2.226.545 were imported and 2.243.962 were exported. However, the real maritime transport of goods in containers from Valencia is given by Table 27, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Valencia in 2012 was 3.414.616 TEU units, from which 1.619.698 were imported and 1.794.918 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Valencia is much in the imports (27%) than in the exports (20%). In other words, a 20% of TEU exported from Valencia in 2012 were empty, while a 27% of the imported ones were empty. While the percentage of empty TEU for imports has been growing progressively from 23% in 2007 to 27% in 2012, the percentage of empty TEU for exports has been decreasing progressively from 28% in 2007 to 20% in 2012. The economic recession is a possible explanation to this fact.

With mainland China the total movement of both loaded and empty TEU from Valencia in 2012 was 636.696 TEU units, from which 420.379 were imported and 216.317 were exported. However, the real maritime transport of goods in containers from Valencia with mainland China is given by Table 30, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Valencia with mainland China in 2012 was 554.479 TEU units, from which 420.026 were imported and 134.453 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Valencia to/from mainland China is 0% for imports and 38% for exports. These values contrast with the previous ones of Valencia with the rest of the World. They show that almost all the containers imported from Valencia coming from mainland China are loaded, while around a 40% of the exported ones from Valencia to mainland China are empty.

Moreover, Table 29 and Table 30 include information about the imports in transit TEU from Port of Valencia coming from mainland China. It can be seen that in 2012, 160.528 out of 420.379 both loaded and empty TEU (160.393 out of 420.026 loaded TEU) were imported in transit from this port when the commercial partner is mainland China, which represents a 38% of the total. This percentage of imports in transit has been increasing gradually since 2007 (18%), showing the increasing importance of Valencia as a Mediterranean hub in the last decade.

From all the sources of information checked, the data concerning the final destination of the imports in transit coming from China was not available. However, from Eurostat the export information from Valencia in terms of TEU could be downloaded. Therefore, the principal commercial partners of the port were noticed. Although the exports from Valencia have nothing to do with the imports in transit from the same port, estimation can be done about where approximately the cargo unloaded in Valencia and loaded into another ship goes to.

Table 32. Destination of TEU exported from Valencia in 2012 (*source: own-source using Eurostat data*)

Destination	TEU exported in 2012 from Valencia	%
Belgium	11.126	0,5
Greece	15.057	0,7
Spain	141.173	6,3
France	29.336	1,3
Italy	59.970	2,7
Portugal	24.154	1,1
United Kingdom	12.212	0,5
Turkey	32.039	1,4
United Arab Emirates	42.055	1,9
Argentina	20.907	0,9
Australia	9.539	0,4
Benin	9.678	0,4
Brazil	119.295	5,3
Canada	90.962	4,1
Chile	17.211	0,8
Cameroon	17.807	0,8
China (except Hong Kong)	216.317	9,6
Colombia	14.100	0,6

Cuba	10.236	0,5
Algeria	238.591	10,6
Egypt	30.663	1,4
Ghana	10.154	0,5
Equatorial Guinea	12.909	0,6
Hong Kong	23.713	1,1
Israel	11.987	0,5
India	20.576	0,9
Japan	7.841	0,3
South Korea	12.049	0,5
Lebanon	12.061	0,5
Libya	8.050	0,4
Morocco	122.648	5,5
Mexico	42.067	1,9
Malaysia	7.369	0,3
Nigeria	54.634	2,4
Panama	8.486	0,4
Peru	10.363	0,5
Russia	27.140	1,2
Saudi Arabia	71.535	3,2
Singapore	10.299	0,5
Senegal	7.843	0,3
Togo	12.040	0,5
Tunisia	27.177	1,2
Taiwan	8.400	0,4
United States	150.220	6,7
Venezuela	8.438	0,4
Others	393.535	17,5

The Asian countries of the list have been marked in red colour in order to separate them from the rest. It is obvious that a container that comes from mainland China will not be imported in transit from Valencia and redirected to mainland China again. To simplify the analysis, these destinations have been added together by regions in the following Table 33, once excluded the Asian countries and reformulated the percentages. From this table, it can be seen that the biggest part of the exports from Valencia go to Africa (35%), while an important part goes to America (28%) and the rest of Europe (20%).

Table 33. Export of TEU from Valencia in 2012 (*source: own-source*)

Destination	%

Europe	20,4
Africa	35,4
America	28,2
Others	16,0

Once observed the influence areas of the exports from Valencia, and considering that we are only interested in the final destination of the imports in transit coming from mainland China, a common sense distribution is done for them. These percentages are taken only as a reference to estimate the importance magnitude of each region in the traffic with mainland China. America plays a big role in the exports from Valencia, but probably would not hold such a high percentage concerning the imports in transit coming from mainland China. Therefore, we reduce it to 10%. On the other side, Africa plays an important role in the exports from Valencia, and it makes sense that also takes a big importance when concerning the imports in transit with China. Therefore, we fix it at 50%. Finally, the imports in transit to the rest of Europe will represent a 30%:

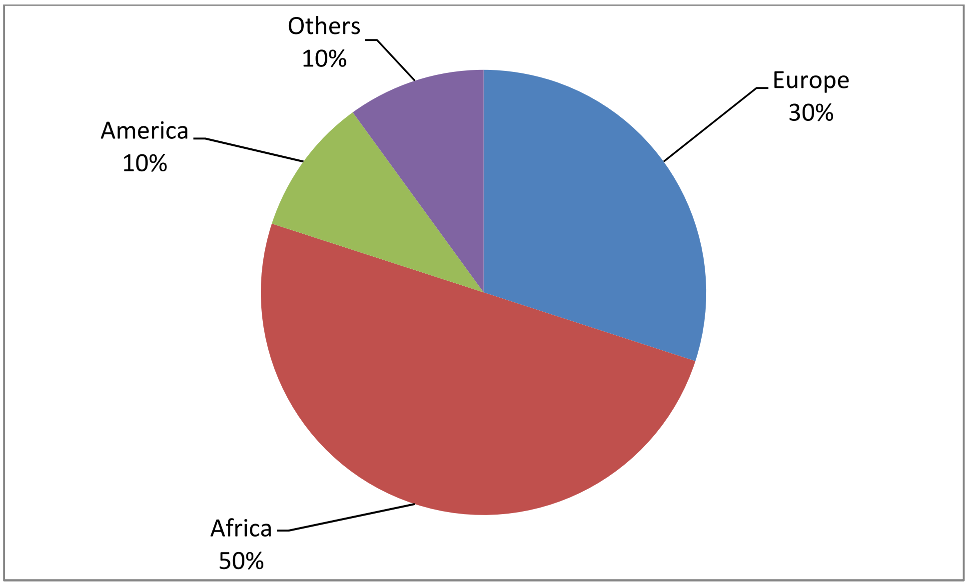


Figure 38. Main final destinations of TEU imported from Valencia with mainland China and transshipped (*source: own-source*)

2.1.5. Hamburg

The Port of Hamburg is situated in Germany, on the river Elbe. The harbour is located 110 km from the mouth of the Elbe into the North Sea. It is named Germany's gateway to the World, and is the largest port in Germany. In terms of TEU throughput, the port of Hamburg is the third-busiest port in Europe (after Rotterdam and Antwerp), and the 15th-largest worldwide.

The harbour covers an area of 73,99 km2, of which 43,31 km2 are land areas. The location is naturally advantaged by a branching Elbe, creating an ideal place for a port complex with warehousing and transhipment facilities. The extensive free port enabled toll-free storing, but this was abandoned in 2013.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Hamburg from the year 2000 until the second semester of 2013 is shown in Figure 39, together with the influence of mainland China as its trade partner. From the third quarter of 2000 until the third quarter of 2008 the amount of TEU transported from Hamburg increased gradually from 1 million TEU quarterly to 2,5 million TEU quarterly. However, in that year the European economic crisis affected strongly the port, which decreased its maritime transport of TEU from 2,5 to 1,7 million both loaded and empty TEU in only one year. From 2009 until 2013 the tendency is to grow up slowly, with a tendency to become stable at around 2,2 million TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Hamburg has increased significantly since 2000.

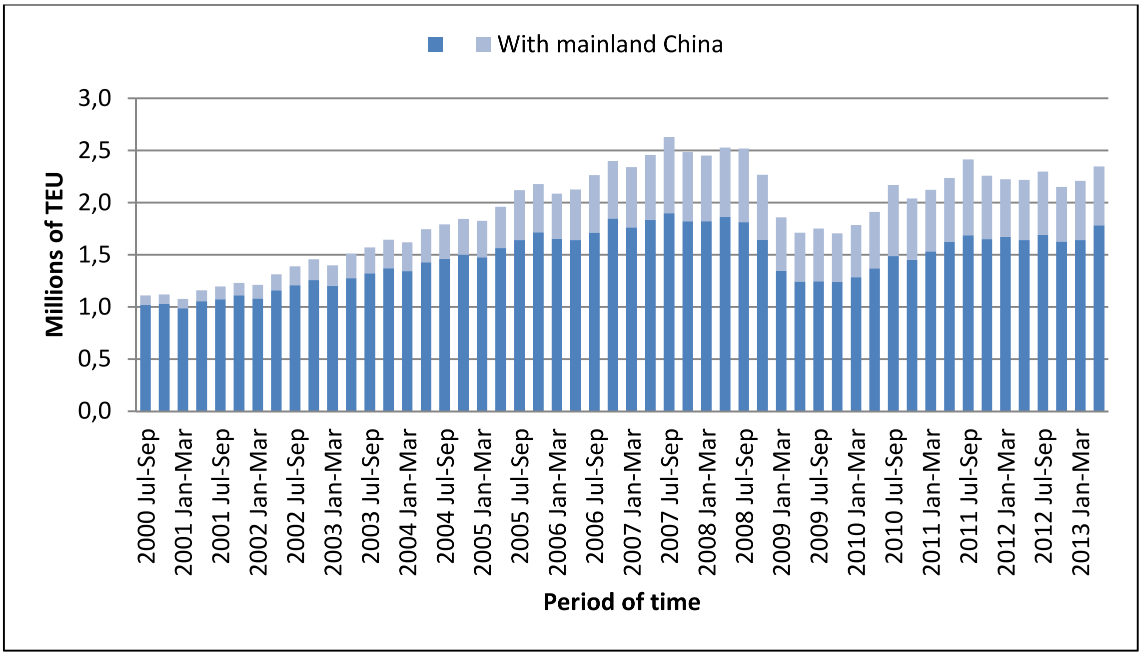


Figure 39. Total maritime transport of both loaded and empty TEU from Hamburg (*source: own-source using Eurostat data*)

The total number of TEU transported from Hamburg and from Hamburg with mainland China is reported here. As for this specific study, also the imports in transit from Hamburg and its use of inland waterways have been recorded thanks to the Port Authority of Hamburg. The rate of empty TEU transported to and from Hamburg has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 34. Number of both loaded and empty TEU transported from Hamburg (*source: own-source using Port Authority of Hamburg data*)

	2006	2007	2008	2009	2010	2011	**2012**

Total export	4.261.958	4.776.189	4.736.836	3.395.808	3.821.959	4.390.323	**4.284.066**
Total import	4.616.135	5.137.342	5.030.430	3.635.120	4.083.559	4.644.768	**4.606.647**
Import in transit excluding IW (63% total import)	2.908.165	3.236.525	3.169.171	2.290.126	2.572.642	2.926.204	**2.902.188**
IW (2*37=0,74% total import)	34.159	38.016	37.225	26.900	30.218	34.371	**34.089**

Table 35. Number of loaded TEU transported from Hamburg (*source: own-source using Port Authority of Hamburg data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	3.497.397	3.680.734	3.699.051	2.843.469	3.124.005	3.655.956	**3.818.940**
Total import	3.901.782	4.296.240	4.243.038	3.176.260	3.547.327	3.992.690	**3.857.178**
Import in transit excluding IW (63% total import)	2.458.123	2.706.631	2.673.114	2.001.044	2.234.816	2.515.395	**2.430.022**
IW (2*37=0,74% total import)	28.873	31.792	31.398	23.504	26.250	29.546	**28.543**

Table 36. Percentage of empty TEU with respect to the total number of TEU transported from Hamburg (*source: own-source using Port Authority of Hamburg data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	18	23	22	16	18	17	**11**
Total import	15	16	16	13	13	14	**16**

Table 37. Number of both loaded and empty TEU transported from Hamburg with mainland China (*source: own-source using Port Authority of Hamburg data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	710.470	973.411	965.804	710.698	886.886	970.452	**791.188**
Total import	1.316.299	1.625.831	1.656.890	1.240.965	1.424.425	1.569.890	**1.471.351**
Import in transit	829.268	1.024.274	1.043.841	781.808	897.388	989.031	**926.951**

excluding IW (63% total import)							
IW (2*37=0,74% total import)	9.741	12.031	12.261	9.183	10.541	11.617	**10.888**

Table 38. Number of loaded TEU transported from Hamburg with mainland China (*source: own-source using Port Authority of Hamburg data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	435.378	436.478	420.994	470.014	503.104	565.742	**570.837**
Total import	1.300.336	1.609.480	1.635.308	1.230.654	1.411.797	1.552.617	**1.451.962**
Import in transit excluding IW (63% total import)	819.212	1.013.972	1.030.244	775.312	889.432	978.149	**914.736**
IW (2*37=0,74% total import)	9.622	11.910	12.101	9.107	10.447	11.489	**10.745**

Table 39. Percentage of empty TEU with respect to the total number of TEU transported from Hamburg with mainland China (*source: own-source using Port Authority of Hamburg data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	39	55	56	34	43	42	**28**
Total import	1	1	1	1	1	1	**1**

The total movement of both loaded and empty TEU from Hamburg in 2012 was 8.890.713 TEU units, from which 4.606.647 were imported and 4.284.066 were exported. However, the real maritime transport of goods in containers from Hamburg is given by Table 35, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Hamburg in 2012 was 7.676.118 TEU units, from which 3.857.178 were imported and 3.818.940 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Hamburg is higher in the imports (16%) than in the exports (11%). In other words, an 11% of TEU exported from Hamburg in 2012 were empty, while a 16% of the imported ones were empty. While the percentage of empty TEU for the imports has been kept more or less constant, the percentage of empty TEU for the exports has been decreasing progressively from 23% in 2007 to 11% in 2012. The economic recession is a possible explanation to this fact.

With mainland China the total movement of both loaded and empty TEU from Hamburg in 2012 was 2.262.539 TEU units, from which 1.471.351 were imported and 791.188 were exported. However, the real maritime transport of goods in containers from Hamburg with mainland China is given by Table 38, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Hamburg with mainland China in 2012 was 2.022.799 TEU units, from which 1.451.962 were imported and 570.837 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Hamburg with mainland China is 1% for imports and 28% for exports. These values contrast with the previous ones of Hamburg with the rest of the World. They show that almost all the containers imported from Hamburg coming from mainland China are loaded, while around a 30% of the exported ones from Hamburg to mainland China are empty, showing the big role that mainland China plays as exporter.

Moreover, Table 37 and Table 38 include information about the imports in transit TEU from Port of Hamburg when the commercial partner is mainland China. It can be seen that in 2012, 926.951 out of 1.471.351 both loaded and empty TEU (914.736 out of 1.451.962 loaded TEU) were imported in transit from this port, which represents a 63% of the total. This percentage agrees with a research carried out by ITMMA, "Economic Analysis of the European Seaport System" (2009), where the rate of transhipment from Hamburg is fixed at 63%; and also agrees with Port of Hamburg available information, which shows that the transhipment rate is 5,7 million TEU out of 8,9 million TEU (64%).

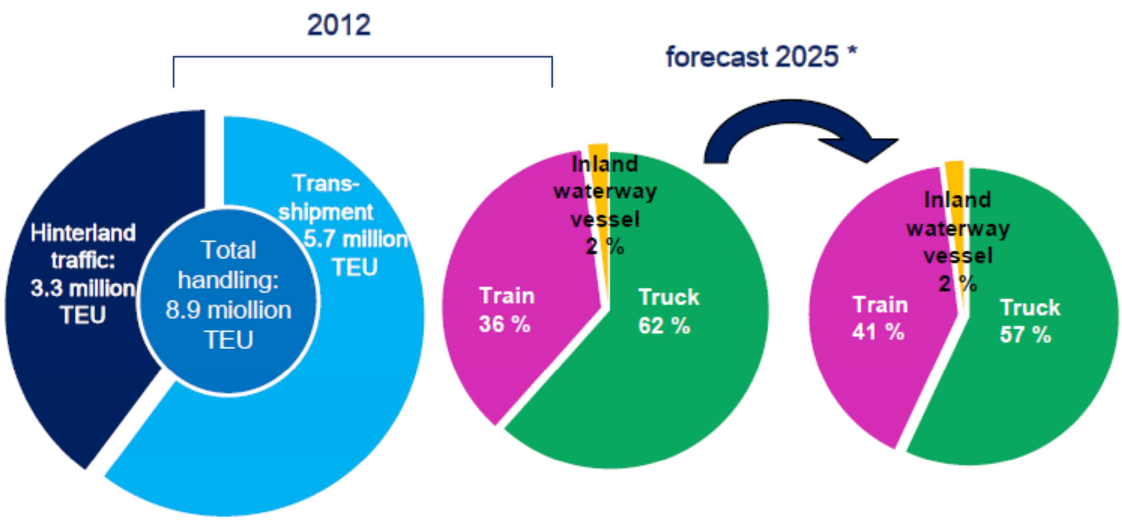


Figure 40. Modal split proportion of Hamburg's hinterland traffic (*source: Port Authority of Hamburg*)

But in Hamburg inland waterway transport also plays an important role. As seen in Figure 40, currently 2% of the number of TEU imported from Hamburg is distributed to the hinterland through inland waterways. If we assume that this percentage can be extrapolated to the case of imports from Hamburg coming from mainland China, then 10.888 out of 1.471.351 both loaded and empty TEU (10.745 out of 1.451.962 loaded TEU) were imported and distributed to the hinterland through inland waterways, which represents a 0,74% of the total.

From all the sources of information checked, the data concerning the final destination of the imports in transit coming from mainland China was not available. However, from the map of feeder weekly departures (2012) from Hamburg, and after discussing with some of the Port of Hamburg representatives in China, it was stated that the main final destination for the imports in transit is the Baltic Sea, and in a lower degree the United Kingdom, South Europe and Transoceanic routes.

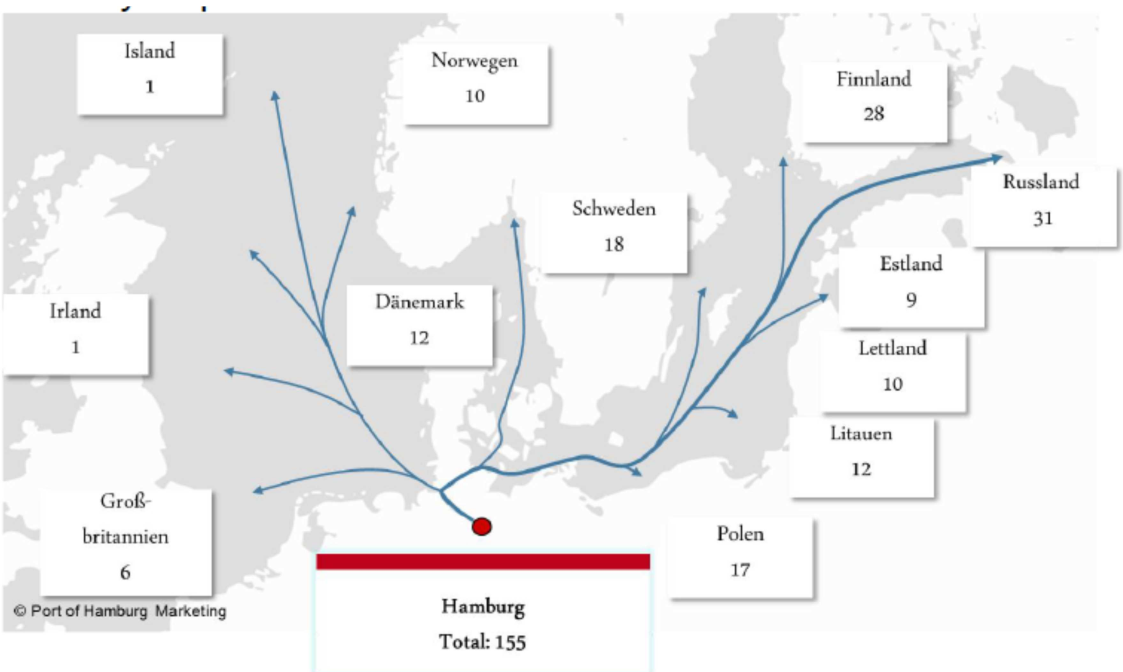


Figure 41. Feeder connections of the port of Hamburg. Weekly departures on 2012 (*source: Port Authority of Hamburg*)

In Hamburg, nevertheless, there will be in the near future a higher competition between the Short Sea Shipping and the road and rail transport. This is due to the conclusion of the Fehmarn Belt Fixed Link Project, which is an immersed tunnel and a bridge that will connect the German Island of Fehmarn with the Danish Island of Lolland. This will cross over the Fehmarn Belt in the Baltic Sea (18 km wide), hence providing a direct link by railroad and highway between northern Germany and Lolland, and thence to the Danish island of Zealand.

Fehmarn Island is already connected by bridge with the German mainland, and Lolland is already connected by a tunnel and bridges with Zealand over the Island Falster. Furthermore, Zealand is already connected with the Swedish coast. Although there is already a fixed bridge-tunnel connection between Zealand and Germany, using the detour over Great Belt, the Fehmarn Belt Fixed Link will provide an easier and speedier route from Germany to Zealand, Sweden and Norway.

The Fehmarn Belt Fixed Link was tentatively expected to be completed in 2018, but the date has changed to 2021. Originally conceived as a bridge, in 2012 it was announced that a tunnel was preferable to a bridge as this would present fewer construction risks, although the financial cost would be broadly similar. The Danish Government approved the project by a large parliamentary majority in 2011.

In summary, although currently the imports in transit from Hamburg play an important role in the North Europe region, especially in the Baltic Sea, in the near future new tendencies can be observed after some improvements in the railroad connections will be carried out, such as the Fehmarn Belt Fixed Link, expected to be finished in 2021.

2.1.6. Rotterdam

The Port of Rotterdam is the largest port in Europe, located in the city of Rotterdam, Netherlands. From 1962 until 2002 it was the world's busiest port, now overtaken by first Singapore and then Shanghai. In 2009, Rotterdam was the world's tenth-largest container port in terms of TEU handled (2008: ninth, 2006: sixth). In 2011 Rotterdam was the world's fifth-largest port in terms of annual cargo tonnage.

Covering 105 square kilometres, the port of Rotterdam now stretches over a distance of 40 km. It consists of five district port areas and three distribution parks that facilitate the needs of a hinterland with 40 million consumers.

Most important for the port of Rotterdam are the petrochemical industry and general cargo transhipment handlings. The harbour functions as an important transit point for transport of bulk and other goods between the European continent and other parts of the world. From Rotterdam goods are transported by ship, river barge, train or road.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Rotterdam from the year 2000 until the second semester of 2013 is shown in Figure 42, together with the influence of mainland China as its trade partner. From the third quarter of 2000 until the second quarter of 2008 the amount of TEU transported from Rotterdam increased gradually from 1,5 million TEU quarterly to 2,7 million both loaded and empty TEU quarterly. However, in that year the European economic crisis affected the port, which decreased its maritime transport of TEU from 2,7 to 2,2 million both loaded and empty TEU in less than one year. From 2009 until 2013 the tendency was to grow up slowly, with a tendency to become stable at around 2,8 million both loaded and empty TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Rotterdam has increased significantly since 2000.

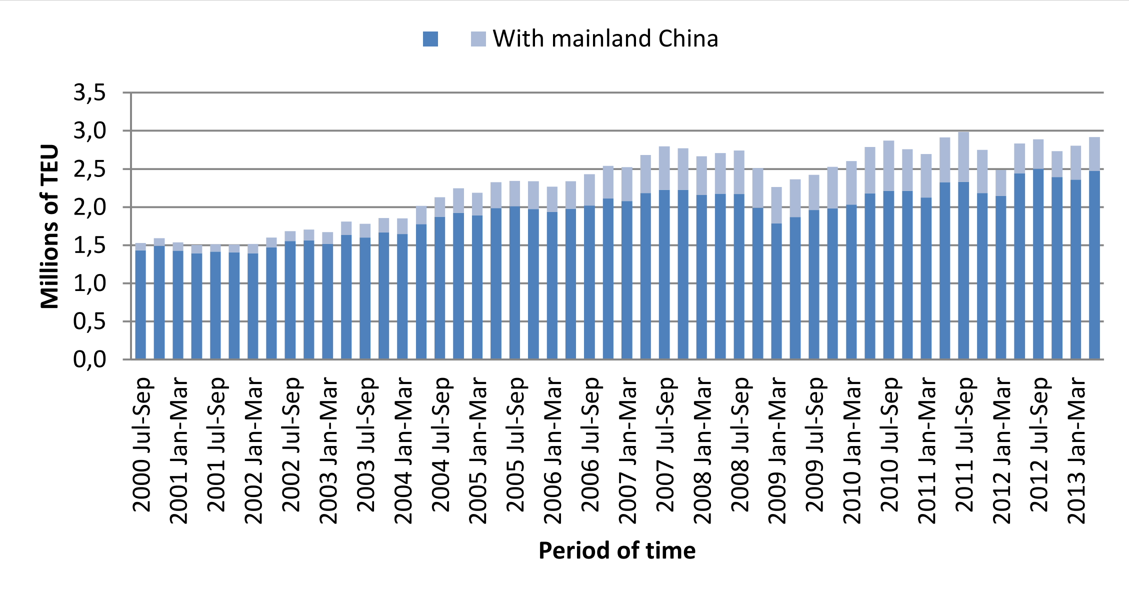


Figure 42. Total maritime transport of both loaded and empty TEU from Rotterdam (*source: own-source using Port Eurostat data*)

The total number of TEU transported from Rotterdam and from Rotterdam with mainland China is reported here. As for this specific study, also the imports in transit from Rotterdam and the inland waterways influence have been recorded.

Table 40. Number of both loaded and empty TEU transported from Rotterdam (*source: own-source using Port Authority of Rotterdam data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	4.643.734	5.238.533	5.133.136	4.715.683	5.184.120	5.207.583	**4.936.187**
Total import	4.931.676	5.534.868	5.497.826	4.863.602	5.833.346	6.132.286	**6.002.317**
Import in transit excluding IW (30% total import)	1.479.503	1.660.460	1.649.348	1.459.081	1.750.004	1.839.686	**1.800.695**
IW (35*70=24,5% total import)	1.208.261	1.356.043	1.346.967	1.191.582	1.429.170	1.502.410	**1.470.568**

Table 41. Number of loaded TEU transported from Rotterdam (*source: own-source using Port Authority of Rotterdam data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	3.695.164	4.021.042	3.909.523	3.813.884	4.615.791	4.151.771	**3.969.686**
Total import	3.898.817	4.408.747	4.497.904	4.146.725	5.417.581	5.048.269	**4.834.196**
Import in transit excluding IW (30% total import)	1.169.645	1.322.624	1.349.371	1.244.018	1.625.274	1.514.481	**1.450.259**
IW (35*70=24,5% total import)	955.210	1.080.143	1.101.986	1.015.948	1.327.307	1.236.826	**1.184.378**

Table 42. Percentage of empty TEU with respect to the total number of TEU transported from Rotterdam (*source: own-source using Port Authority of Rotterdam data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	20	23	24	19	11	20	**20**
Total import	21	20	18	15	7	18	**19**

Table 43. Number of both loaded and empty TEU transported from Rotterdam with mainland China (*source: own-source using Port Authority of Rotterdam data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	586.297	882.222	945.846	866.685	939.775	832.642	**22.910**
Total import	944.734	1.177.985	1.190.703	1.114.112	1.444.196	1.545.098	**1.430.011**
Import in transit excluding IW (30% total import)	283.420	353.396	357.211	334.234	433.259	463.529	**429.003**
IW (35*70=24,5% total import)	231.460	288.606	291.722	272.957	353.828	378.549	**350.353**

Table 44. Number of loaded TEU transported from Rotterdam with mainland China (*source: own-source using Port Authority of Rotterdam data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	383.149	508.421	545.483	613.237	730.124	821.383	**13.033**

Total import	911.738	1.149.280	1.164.302	1.105.199	1.440.788	1.528.522	**1.415.554**
Import in transit excluding IW (30% total import)	273.521	344.784	349.291	331.560	432.236	458.557	**424.666**
IW (35*70=24,5% total import)	223.376	281.574	285.254	270.774	352.993	374.488	**346.811**

Table 45. Percentage of empty TEU with respect to the total number of TEU transported from Rotterdam with mainland China (*source: own-source using Port Authority of Rotterdam data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	35	42	42	29	22	1	**43**
Total import	3	2	2	1	0	1	**1**

The total movement of both loaded and empty TEU from Rotterdam in 2012 was 10.938.504 TEU units, from which 6.002.317 were imported and 4.936.187 were exported. However, the real maritime transport of goods in containers from Rotterdam is given by Table 41, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Rotterdam in 2012 was 8.803.882 TEU units, from which 4.834.196 were imported and 3.969.686 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Rotterdam in the imports (19%) is similar to the exports (20%). In other words, a 20% of TEU exported from Rotterdam in 2012 were empty, while a 19% of the imported ones were empty.

With mainland China the total movement of both loaded and empty TEU from Rotterdam in 2012 was 1.452.921 TEU units, from which 1.430.011 were imported and 22.910 were exported. The exported amount of TEU from Rotterdam to mainland China has decreased significantly in 2012, given that in the previous years the exported TEU from Rotterdam to mainland China was around the million. However, the real maritime transport of goods in containers from Rotterdam with mainland China is given by Table 44, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Rotterdam with mainland China in 2012 was 1.428.587 TEU units, from which 1.415.554 were imported and 13.033 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Rotterdam with mainland China is 1% for imports and 43% for exports. These values contrast with the previous ones of Rotterdam with the rest of the World. They show that almost all the containers imported from Rotterdam coming from mainland China are loaded, while around a 45% of the exported ones from Rotterdam to mainland China are empty, showing the big role that China plays as exporter in the World.

Moreover, Table 43 and Table 44 include information about the imports in transit TEU from Port of Rotterdam when the commercial partner is mainland China. It can be seen that in 2012, 1.800.695 out of 6.002.317 both loaded and empty TEU (1.450.259 out of 4.834.196 loaded TEU) were imported in transit from this port, which represents a 30% of the total. This percentage agrees with a research carried out by ITMMA, "Economic Analysis of the European Seaport System" (2009), where the rate of transhipment from Rotterdam is fixed at 25%; and also agrees with Port of Rotterdam available information.

As we are only interested in the imports in transit from Rotterdam of the TEU coming from China, and there is no data available for that, some other sources of information were used to do estimation. First of all, from the official Port of Rotterdam statistics, in 2012 both imports and exports of containers could split up into that ones from/to hinterland (64%) and containers pertaining to feeder throughput (36%). From the ones from/to hinterland, a 35% went through inland waterways, an 11% by rail and a 54% by road.

On the other side, from the research carried out by ITMMA, "Economic Analysis of the European Seaport System" (2009), the proportion of hinterland traffic concerning about TEU in Rotterdam is 75%, therefore the transhipment rate is the complementary: 25%.

Finally, when contacting Ming Yue Lian, the Chief Representative of Port of Rotterdam in Shanghai, and Joyce Bliek, the Director of the Containers and Breakbulk department of Port of Rotterdam, they both fix the transhipment rate at 30% (excluding the inland waterways transport, which represents a 35% of the hinterland transport (70%)).

Port of Rotterdam, however, does not have the knowledge and recorded information to state whether or not these percentages can also be applied when the maritime partner is mainland China. Nevertheless, it is reasonable to think that they are, so we assume them as a good approximation.

Table 46. Modal split containers from Port of Rotterdam, 2009-2012 (*source: Port Authority of Rotterdam*)

MODEL SPLIT CONTAINERS

	2012	%	2011	%	2010	%	2009	%
Barge	2.613	35,3	2.393	33,4	2.351	32,8	2.200	33,4
Rail	794	10,7	818	11,4	755	10,5	735	11,2
Road	3.998	54,0	3.951	55,2	4.057	56,6	3.644	55,4
Total	**7.405**	**100,0**	**7.162**	**100,0**	**7.163**	**100,0**	**6.579**	**100,0**
From/to Hinterland	7.405	63,5	7.162	61,1	7.163	65,3	6.579	68,6
Feeder throughput	4.265	36,5	4.556	38,9	3.809	34,7	3.014	31,4
Total	**11.670**	**100,0**	**11.718**	**100,0**	**10.972**	**100,0**	**9.593**	**100,0**
To/from Depot	192		160		176		175	
Total	**11.862**		**11.878**		**11.148**		**9.768**	

Assuming this, it can be seen that in 2012, 429.003 out of the 1.430.011 both loaded and empty TEU coming from mainland China (424.666 out of 1.415.554 loaded TEU) were imported in transit from this port, which represents a 30% of the total, as stated before. This amount of TEU does not include the inland waterways movements of TEU. Port of Rotterdam, therefore, has approximately two times the rate of transhipment of Barcelona (17%).

In addition, as said before, the inland waterway transport in Port of Rotterdam represents a 35% of the hinterland traffic (70%). Again, if we use these percentages in the specific case of imports from Rotterdam coming from mainland China, it can be concluded that in 2012, 350.353 out of 1.430.011 both loaded and empty TEU (346.811 out of 1.415.554 loaded TEU) were imported and redirected to the hinterland through inland waterways.

Therefore, if we add together the imports in transit and the imports to the hinterland through inland waterways, it is observed that in 2012, 779.356 both loaded and empty TEU out of 1.430.011 (55%) (771.477 out of 1.415.554 loaded TEU) were imported from Rotterdam coming from mainland China and distributed to their final destination either by Short Sea Shipping, a transoceanic route or inland waterways.

From all the sources of information checked, the data concerning the final destination of the imports in transit coming from China was not available. However, after discussing with some of the Port of Rotterdam representatives in China, it was stated that the main final destinations for these imports in transit is the Baltic Sea and the United Kingdom, and in a lower degree South Europe and Transoceanic routes.

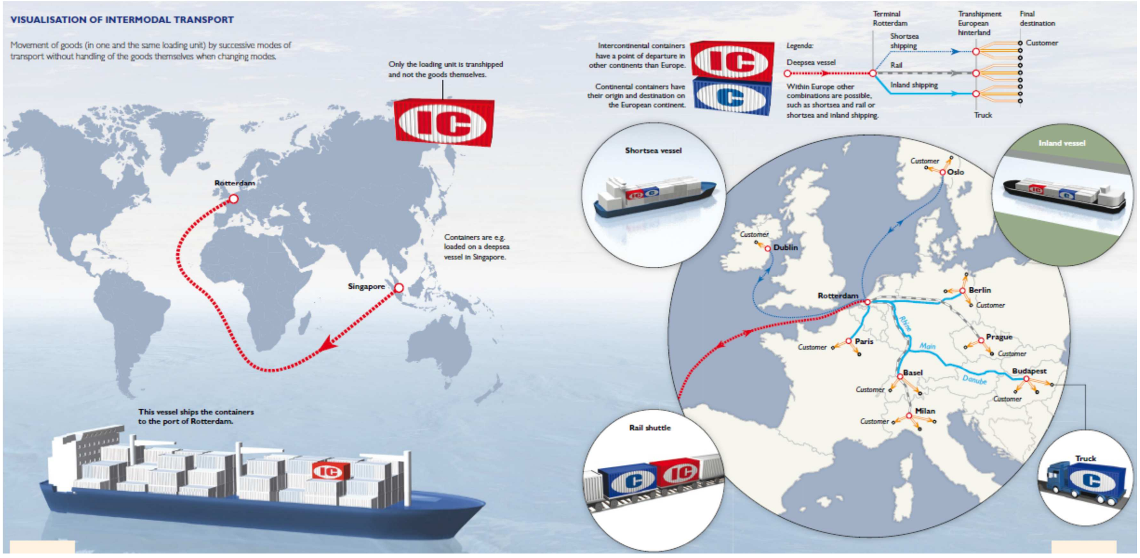


Figure 43. Visualisation of intermodal transport in Rotterdam (*source: Port Authority of Rotterdam*)

2.1.7. Felixstowe

The Port of Felixstowe is the United Kingdom's busiest container port, dealing with over 40% of Britain's containerised trade. In 2011, it was ranked the 35th busiest container port in the world and Europe's sixth busiest.

The port is operated by the Felixstowe Dock and Railway Company which was set up under an Act of Parliament. It is one of the few limited companies in the UK that do not have the word "Limited" in their name. Much of the land on which it sits is owned by Trinity College, Cambridge, which in the 1930s bought some land near Felixstowe which included a dock which was too small to be included in the National Dock Labour Scheme.

In 1967, it set up Britain's first container terminal. The dock was developed into Britain's largest container port. In terms of freight volumes, Felixstowe is Britain's largest port handling 42% of Britain's container trade. Felixstowe is owned by Hutchison Port Holdings (HPH) Group. The port has always been privately owned.

With England receiving the vast majority of the UK's imports by value, the pattern of imports to England largely determines that for the UK as a whole. Table 47 shows that the total value of imports to England decreased by 1,1% during 2013. There was some change in England's top five import partner group during the year: imports from the USA decreased, moving the USA down to fourth position, while those from the Netherlands increased, moving the Netherlands up into third position. Norway has now dropped out of the top five and is replaced by France; imports from France rose by 4,7% during the year. Germany remains the top import partner for England by a wide margin. Imports from here have risen by 6,5% during the year, the largest percentage increase among the top five. China remains the second highest import partner with a 3,9% annual increase in goods imported from here.

Table 47. Top five import partners, year ending December 2013 (*source: HM Revenue and Customs Regional Trade Statistics*)

	Country	Year ending December 2013 Total £ millions	Year ending December 2012 Total £ millions	% Change from December 2012	% Total Imports in year ending December 2013
Top 5	Germany	48,384.1	45,451.8	6.5	14.2
	China	27,414.0	26,380.1	3.9	8.0
	Netherlands	26,176.6	24,647.8	6.2	7.7
	USA	25,333.2	26,215.9	-3.4	7.4
	France	20,009.9	19,110.8	4.7	5.9
	Others	193,585.4	203,012.7	-4.6	56.8
	Total EU	177,821.4	173,125.0	2.7	52.2
	Total Non-EU	163,081.9	171,694.0	-5.0	47.8
	Grand Total	340,903.3	344,819.0	-1.1	100.0

Note: 2013 data are provisional
Source: HM Revenue & Customs Regional Trade Statistics

Non-EU partner countries accounted for 47,8% of England's imports during 2013; this percentage has fallen slightly from 49,8% in 2012. The growth rate in imports from the EU in 2013 was 2,7%, compared with a decrease of 5,0% for non-EU countries.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Felixstowe from the year 2000 until the second semester of 2013 is shown in Figure 44, together with the influence of mainland China as its trade partner. The amount of both loaded and empty TEU has been kept more or less constant in this period, slightly increasing from 2003 until 2008, decreasing a little bit in the following year and increasing again to reach a stable value of 0,8 million TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Felixstowe has increased significantly since 2000, representing in 2013 more than one third of the total transport of TEU from the port.

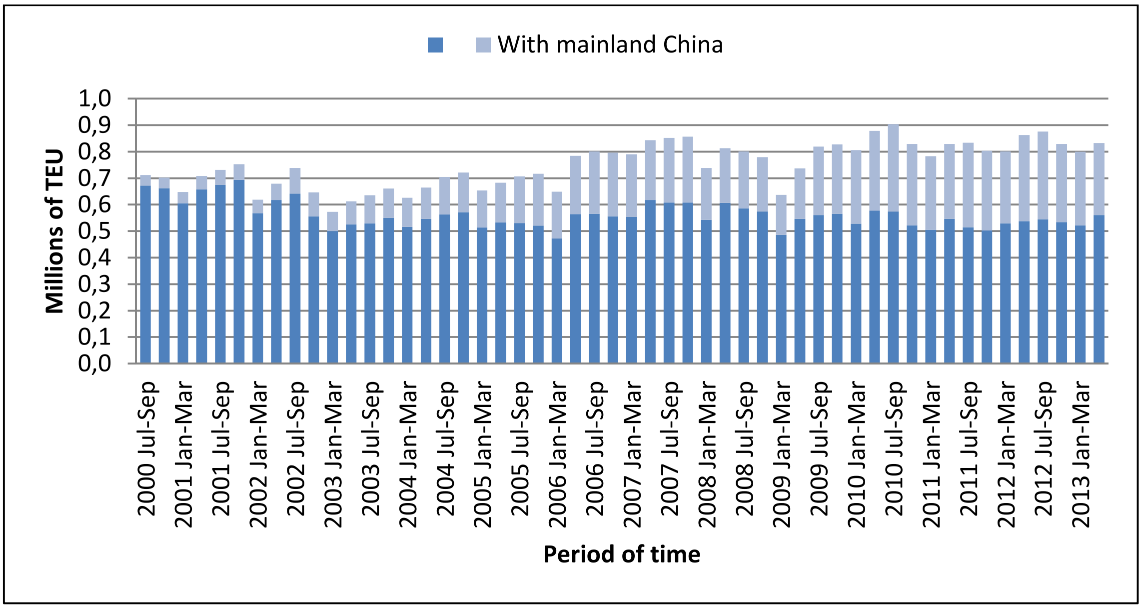


Figure 44. Total maritime transport of both loaded and empty TEU from Felixstowe (*source: own-source using Eurostat data*)

The total number of TEU transported from Felixstowe and from Felixstowe with mainland China is reported here. As for this specific study, also the imports in transit from Felixstowe have been recorded.

Table 48. Number of both loaded and empty TEU transported from Felixstowe (*source: own-source using Port Authority of Felixstowe data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	1.476.789	1.619.715	1.523.107	1.447.895	1.673.430	1.536.429	**1.665.293**
Total import	1.553.018	1.722.557	1.608.320	1.573.049	1.741.707	1.712.163	**1.702.375**
Import in transit (12% total import)	186.362	206.707	192.998	188.766	209.005	205.460	**204.285**

Table 49. Number of loaded TEU transported from Felixstowe (*source: own-source using Port Authority of Felixstowe data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	722.870	736.695	750.587	755.538	784.581	751.871	**846.252**
Total import	1.504.795	1.682.662	1.552.812	1.516.269	1.715.676	1.667.523	**1.665.723**

Import in transit (12% total import)	180.575	201.919	186.337	181.952	205.881	200.103	**199.887**

Table 50. Percentage of empty TEU with respect to the total number of TEU transported from Felixstowe (*source: own-source using Port Authority of Felixstowe data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	51	55	51	48	53	51	**49**
Total import	3	2	3	4	1	3	**2**

Table 51. Number of both loaded and empty TEU transported from Felixstowe with mainland China (*source: own-source using Port Authority of Felixstowe data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	361.901	332.071	256.491	299.119	533.285	510.115	**538.994**
Total import	509.875	625.234	564.887	564.249	680.893	671.083	**680.804**
Import in transit (12% total import)	61.185	75.028	67.786	67.710	81.707	80.530	**81.696**

Table 52. Number of loaded TEU transported from Felixstowe with mainland China (*source: own-source using Port Authority of Felixstowe data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	104.780	109.362	99.213	143.013	130.130	153.297	**202.194**
Total import	507.452	622.912	563.921	563.480	680.023	670.258	**679.414**
Import in transit (12% total import)	60.894	74.749	67.671	67.618	81.603	80.431	**81.530**

Table 53. Percentage of empty TEU with respect to the total number of TEU transported from Felixstowe with mainland China (*source: own-source using Port Authority of Felixstowe data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	71	67	61	52	76	70	**62**
Total import	0	0	0	0	0	0	**0**

The total movement of both loaded and empty TEU from Felixstowe in 2012 was 3.367.688 TEU units, from which 1.702.375 were imported and 1.665.293 were exported. However, the real maritime transport of goods in containers from Felixstowe is given by Table 49, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Felixstowe in 2012 was 2.511.975 TEU units, from which 1.665.723 were imported and 846.252 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Felixstowe is much higher in the exports (49%) than in the imports (2%). In other words, a 49% of TEU exported from Felixstowe in 2012 were empty, while only a 2% of the imported ones were empty. These values have not changed significantly in the past few years, and they show the role as importer rather than exporter of Felixstowe, which has to supply a huge amount of goods to the population of the UK.

With mainland China the total movement of both loaded and empty TEU from Felixstowe was 1.219.798 TEU units, from which 680.804 were imported and 538.994 were exported. However, the real maritime transport of goods in containers from Felixstowe with mainland China is given by Table 52, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Felixstowe with mainland China in 2012 was 881.608 TEU units, from which 679.414 were imported and 202.194 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Felixstowe with mainland China is now even higher than before in the exports (62%) than in the imports (0%). In other words, only 1.390 out of 680.804 TEU imported from Felixstowe coming from mainland China in 2012 were empty, while a 62% of the exported ones to mainland China were empty. These values show that almost all the containers imported from Felixstowe coming from mainland China are loaded, while more than a half of the exported ones to mainland China (62%) are empty.

Moreover, Table 51 and Table 52 include information about the import in transit TEU from Port of Felixstowe when the commercial partner is mainland China. It can be seen that in 2012, 81.696 out of 680.804 both loaded and empty TEU (81.530 out of 679.414 loaded TEU) were imported in transit from this port, which represents a 12% of the total. This rate of transhipment is taken from *Felixstowe Port Logistics Study*, a report submitted by GHK in 2010.

2.1.8. Bremerhaven

Bremerhaven, literally “Bremen’s harbour”, is a city at the seaport of Free Hanseatic City of Bremen, a state of the Federal Republic of Germany. It forms an enclave in the state of Lower Saxony and is located at the mouth of the River Weser on its eastern bank, opposite the town of Nordenham. Though a relatively new city, it has a long history as a trade port and today is one of the most important German ports, playing a crucial role in Germany’s trade.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Bremerhaven from the year 2000 until the second semester of 2013 is shown in Figure 45, together with the influence of mainland China as its trade partner. From the third quarter of 2000 until the third quarter of 2008 the amount of TEU transported from Bremerhaven increased gradually from 0,6 million TEU quarterly to 1,4 million TEU quarterly. However, in that year the European economic crisis affected strongly the port, which decreased its maritime transport of TEU from 1,4 to 1 million both loaded and empty TEU in less than one year. From 2009 until 2013 the tendency is to grow up slowly, with a tendency to become stable at around 1,5 million both loaded and empty TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Bremerhaven has increased significantly since 2000.

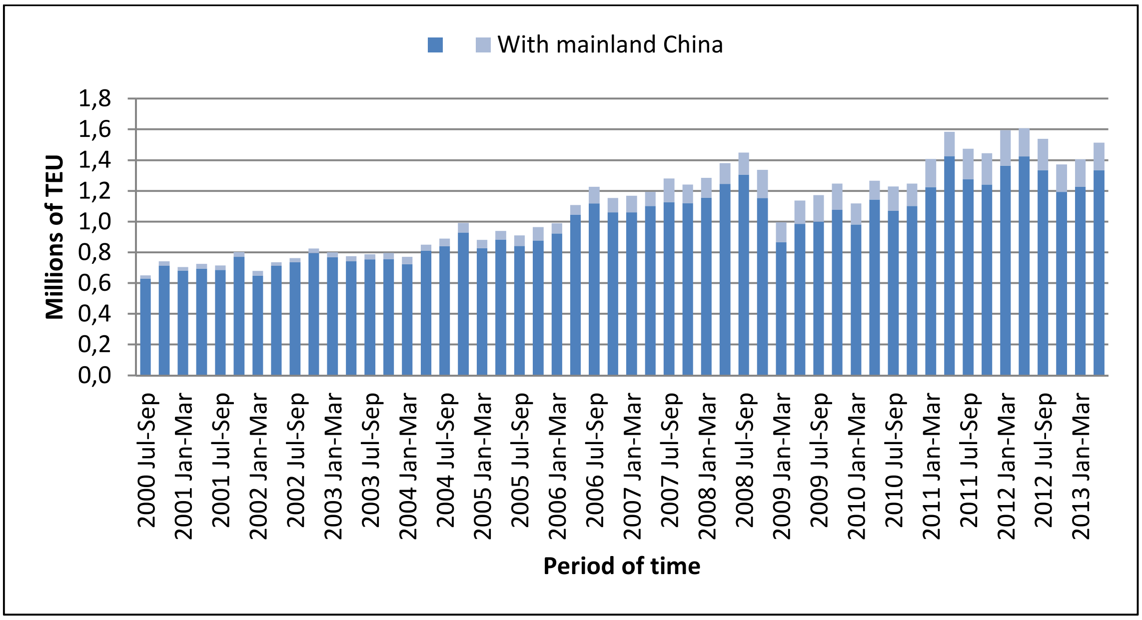


Figure 45. Total maritime transport of total loaded and empty TEU from Bremerhaven (*source: own-source using Eurostat data*)

The total number of TEU transported from Bremerhaven and from Bremerhaven with mainland China is reported here. As for this specific study, also the imports in transit from Bremerhaven and the inland waterways influence have been recorded.

Table 54. Number of both loaded and empty TEU transported from Bremerhaven (*source: own-source using Port Authority of Bremerhaven data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	2.343.650	2.529.294	2.828.091	2.359.037	2.533.446	3.056.755	**3.163.508**
Total import	2.135.669	2.354.665	2.623.298	2.192.990	2.324.882	2.854.462	**2.947.692**
Import in transit excluding IW	1.302.758	1.436.346	1.600.212	1.337.724	1.418.178	1.741.222	**1.798.092**

(61% total import)							
IW (4,3*39=1,7% total import)	36.306	40.029	44.596	37.281	39.523	48.526	**50.111**

Table 55. Number of loaded TEU transported from Bremerhaven (*source: own-source using Port Authority of Bremerhaven data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	2.065.172	2.274.752	2.537.266	2.161.862	2.359.413	2.779.406	**2.936.769**
Total import	1.740.214	1.931.852	2.220.010	1.847.068	1.997.771	2.378.042	**2.484.115**
Import in transit excluding IW (61% total import)	1.061.531	1.178.430	1.354.206	1.126.711	1.218.640	1.450.606	**1.515.310**
IW (4,3*39=1,7% total import)	29.584	32.841	37.740	31.400	33.962	40.427	**42.230**

Table 56. Percentage of empty TEU with respect to the total number of TEU transported from Bremerhaven (*source: own-source using Port Authority of Bremerhaven data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	12	10	10	8	7	9	**7**
Total import	19	18	15	16	14	17	**16**

Table 57. Number of both loaded and empty TEU transported from Bremerhaven with mainland China (*source: own-source using Port Authority of Bremerhaven data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	165.092	208.253	245.915	255.398	220.352	294.025	**323.649**
Total import	167.472	269.789	347.204	369.001	342.225	450.777	**473.912**
Import in transit excluding IW (61% total import)	102.158	164.571	211.794	225.091	208.757	274.974	**289.086**
IW (4,3*39=1,7%	2.847	4.586	5.902	6.273	5.818	7.663	**8.057**

total import)							

Table 58. Number of loaded TEU transported from Bremerhaven with mainland China (*source: own-source using Port Authority of Bremerhaven data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	93.187	106.649	128.711	209.381	145.569	175.044	**244.387**
Total import	164.814	267.253	344.259	364.277	338.260	445.122	**468.250**
Import in transit excluding IW (61% total import)	100.537	163.024	209.998	222.209	206.339	271.524	**285.633**
IW (4,3*39=1,7% total import)	2.802	4.543	5.852	6.193	5.750	7.567	**7.960**

Table 59. Percentage of empty TEU with respect to the total number of TEU transported from Bremerhaven with mainland China (*source: own-source using Port Authority of Bremerhaven data*)

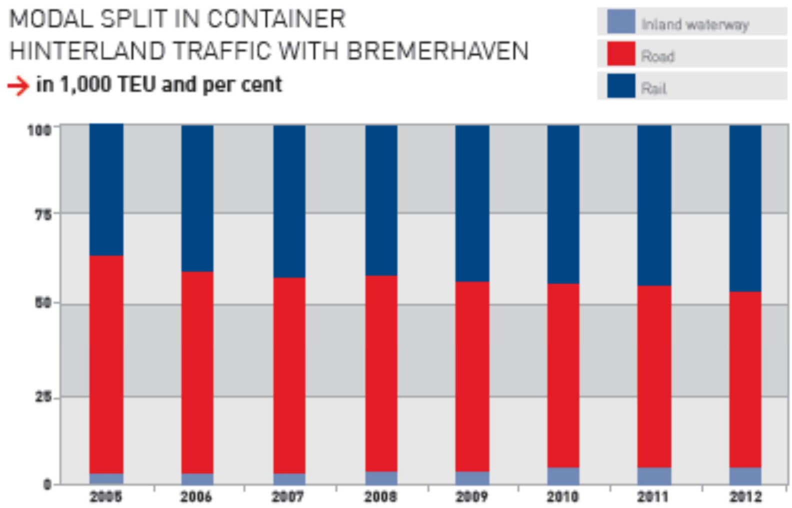
	2006	2007	2008	2009	2010	2011	**2012**
Total export	44	49	48	18	34	40	**24**
Total import	2	1	1	1	1	1	**1**

The total movement of both loaded and empty TEU from Bremerhaven in 2012 was 6.111.200 TEU units, from which 2.947.692 were imported and 3.163.508 were exported. However, the real maritime transport of goods in containers from Bremerhaven is given by Table 55, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Bremerhaven in 2012 was 5.420.884 TEU units, from which 2.484.115 were imported and 2.936.769 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Bremerhaven is higher in the imports (16%) than in the exports (7%). In other words, a 7% of TEU exported from Bremerhaven in 2012 were empty, while a 16% of the imported ones were empty. These values have not changed significantly in the past few years, and they show that Bremerhaven is more an exporter port than an importer one.

With mainland China the total movement of both loaded and empty TEU from Bremerhaven was 797.561 TEU units, from which 473.912 were imported and 323.649 were exported. However, the real maritime transport of goods in containers from Bremerhaven with mainland China is given by Table 58, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Bremerhaven with China in 2012 was 712.637 TEU units, from which 468.250 were imported and 244.387 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Bremerhaven with China is now higher in the exports (24%) than in the imports (1%). In other words, only 5.662 out of 473.912 TEU imported from Bremerhaven coming from mainland China in 2012 were empty, while a 24% of the exported ones to mainland China were empty. These values show that almost all the containers imported from Bremerhaven coming from mainland China are loaded, while almost a quarter of the exported ones (24%) are empty.

Moreover, Table 57 and Table 58 include information about the imports in transit TEU from Port of Bremerhaven when the commercial partner is mainland China. It can be seen that in 2012, 289.086 out of 473.912 both loaded and empty TEU (285.633 out of 468.250 loaded TEU) were imported in transit from this port, which represents a 61% of the total. This percentage agrees with a research carried out by ITMMA, “Economic Analysis of the European Seaport System” (2009), where the rate of transhipment from Hamburg is fixed at 61%.

But in Bremerhaven inland waterway transport also plays an important role. As seen in Figure 46, currently 4,3% of the number of TEU imported from Hamburg and not transshipped is distributed to the hinterland through inland waterways. If we assume that this percentage can be extrapolated to the case of imports from Bremerhaven coming from China, then 8.057 out of 473.912 both loaded and empty TEU (7.960 out of 468.250 loaded TEU) were imported and distributed to the hinterland through inland waterways, which represents a 1,7% of the total.



Year	Inland waterway 1,000 TEU	Inland waterway %	Road 1,000 TEU	Road %	Rail 1,000 TEU	Rail %	Total
2005	37	2.6	857	60.1	531	37.3	1,425
2006	45	2.7	932	56.0	688	41.3	1,666
2007	54	2.8	1,028	54.3	812	42.9	1,894
2008	56	2.7	1,105	54.5	867	42.8	2,028
2009	53	3.0	934	52.5	792	44.5	1,778
2010	85	4.4	970	50.6	863	45.0	1,918
2011	87	4.1	1,057	50.2	964	45.7	2,108
2012	95	4.3	1,066	48.4	1,042	47.3	2,203

Figure 46. Modal Split in container. Hinterland traffic with Bremerhaven (*source: Port Authority of Bremerhaven*)

From all the sources of information checked, the data concerning the final destination of the imports in transit coming from mainland China was not available. However, as Bremerhaven is in the same area as Hamburg, and after discussing with some of the Port of Bremerhaven representatives in China, it was stated that the main final destination for the imports in transit is the Baltic Sea, and in a lower degree the United Kingdom, South Europe and Transoceanic routes.

2.1.9. Le Havre

The Port of Le Havre is the Port and port authority of the Normandie city of Le Havre, France. The Port of Le Havre consists of a series of canal-like docks, the Canal de Tancarville and the Grand Canal du Havre, that connect Le Havre to the Seine, close to the Pont de Tancarville.

The Port of Le Havre is managed by a state agency called *Grand Port Maritime du Havre* since 2008 and replacing the former *Port Autonome du Havre*, that had been created along with Bourdeaux by the first bill on port autonomy in 1920. The *Grand Port Maritime du Havre* is a public institution taking care of administrative public service tasks and missions of industrial and commercial public service. It is operated as a public institution of trade and industry and is responsible for the management of all port facilities in its district.

The Port of Le Havre deals with every type of commodities thanks to the diversity of its terminals. Le Havre was the first container port in France and as a consequence retains a lot of facilities. Nowadays, the port of Le Havre includes three sets of terminals dedicated to containers and 6,5 km of docks.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Le Havre from the year 2000 until the second semester of 2011 is shown in Figure 47, together with the influence of mainland China as its trade partner. For this port there was no data available for years 2012 and 2013. The total amount of both loaded and empty TEU transported from Le Havre increased gradually from 0,3 million TEU quarterly in 2000 to 0,7 million TEU quarterly in 2008, when the European economic crisis started. Then it dropped down to 0,5 million TEU quarterly in less than one year, and after increased again to reach a certain stability at around 0,5-0,6 million TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Le Havre has increased significantly since 2000.

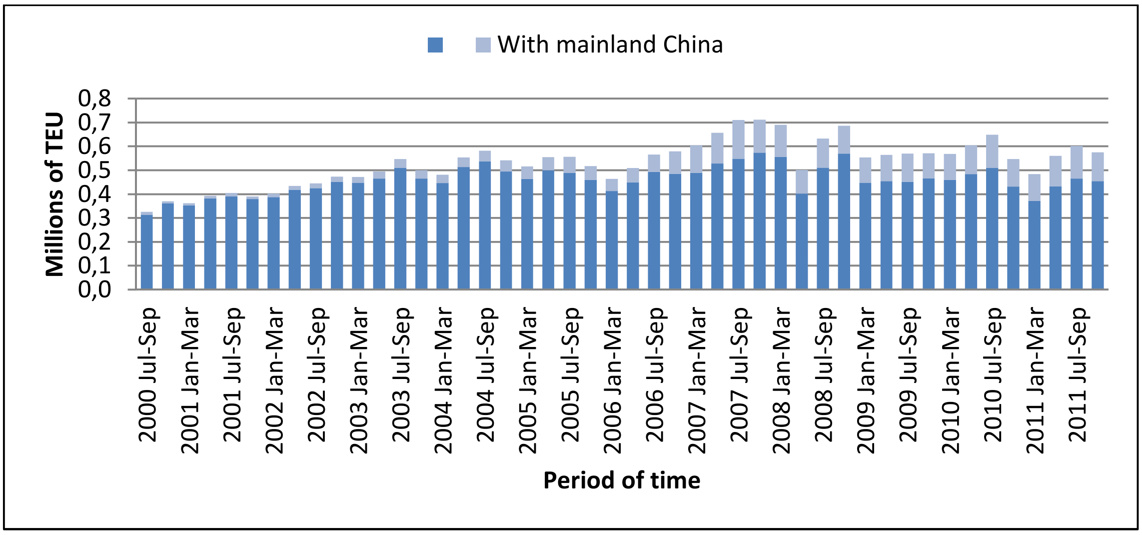


Figure 47. Total maritime transport of both loaded and empty TEU from Le Havre (*source: own-source using Eurostat data*)

The total number of TEU transported from Le Havre and from Le Havre with mainland China is reported here. As for this specific study, also the imports in transit from Le Havre and its use of inland waterways have been recorded thanks to the Port Authority of Le Havre. The rate of empty TEU transported to and from Le Havre has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 60. Number of both loaded and empty TEU transported from Le Havre (*source: own-source using Port Authority of Le Havre data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	1.056.545	1.331.943	1.251.132	1.126.898	1.188.387	1.102.215	**1.086.123**
Total import	1.062.320	1.352.756	1.260.481	1.130.339	1.180.895	1.119.635	**1.028.668**
Import in transit excluding IW (29% total import)	308.073	392.299	365.539	327.798	342.460	324.694	**298.314**
IW (9*71=6,4% total import)	67.988	86.576	80.671	72.342	75.577	71.657	**65.835**

Table 61. Number of loaded TEU transported from Le Havre (*source: own-source using Port Authority of Le Havre data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	894.034	1.065.233	1.004.683	929.724	971.305	918.892	**905.475**
Total import	894.183	1.148.864	1.086.373	949.725	1.021.147	950.238	**873.010**
Import in transit excluding IW (29% total import)	259.313	333.171	315.048	275.420	296.133	275.569	**253.173**
IW (9*71=6,4% total import)	57.228	73.527	69.528	60.782	65.353	60.815	**55.873**

Table 62. Percentage of empty TEU with respect to the total number of TEU transported from Le Havre (*source: own-source using Port Authority of Le Havre data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total	15	20	20	17	18	17	**17**

export							
Total import	16	15	14	16	14	15	**15**

Table 63. Number of both loaded and empty TEU transported from Le Havre with mainland China (*source: own-source using Port Authority of Le Havre data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	91.143	198.834	110.649	116.097	93.262	107.064	**105.496**
Total import	187.642	346.757	361.565	321.017	392.261	392.026	**360.154**
Import in transit excluding IW (29% total import)	54.416	100.560	104.854	93.095	113.756	113.688	**104.445**
IW (9*71=6,4% total import)	12.009	22.192	23.140	20.545	25.105	25.090	**23.050**

Table 64. Number of loaded TEU transported from Le Havre with mainland China (*source: own-source using Port Authority of Le Havre data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	41.269	67.872	68.895	93.433	93.165	106.944	**105.376**
Total import	186.748	344.853	354.490	318.655	389.258	386.198	**354.799**
Import in transit excluding IW (29% total import)	54.157	100.007	102.802	92.410	112.885	111.997	**102.892**
IW (9*71=6,4% total import)	11.952	22.071	22.687	20.394	24.913	24.717	**22.707**

Table 65. Percentage of empty TEU with respect to the total number of TEU transported from Le Havre with mainland China (*source: own-source using Port Authority of Le Havre data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	55	66	38	20	0	0	**0**
Total import	0	1	2	1	1	1	**1**

The total movement of both loaded and empty TEU from Le Havre in 2012 was 2.114.791 TEU units, from which 1.028.668 were imported and 1.086.123 were exported. However, the real maritime transport of goods in containers from Le Havre is given by Table 61, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Le Havre in 2012 was 1.778.485 TEU units, from which 873.010 were imported and 905.475 were exported. The percentage of imported empty TEU with respect to the total number of TEU imported from Le Havre (15%) is similar to the exported empty ones (17%). In other words, a 17% of TEU exported from Le Havre in 2012 were empty, while a 15% of the imported ones were empty. Both percentages of empty TEU have been kept more or less constant during the last decade.

With mainland China the total movement of both loaded and empty TEU from Le Havre in 2012 was 465.650 TEU units, from which 360.154 were imported and 105.496 were exported. However, the real maritime transport of goods in containers from Le Havre with mainland China is given by Table 64, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Le Havre with mainland China in 2012 was 460.175 TEU units, from which 354.799 were imported and 105.376 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Le Havre with mainland China is 1% for imports and 0% for exports. These values contrast with the previous ones of Le Havre with the rest of the World. They show that almost all the containers both imported and exported from Le Havre with mainland China are loaded, showing the intensity of the maritime commerce between mainland China and Le Havre.

Moreover, Table 63 and Table 64 include information about the imports in transit TEU from Port of Le Havre when the commercial partner is mainland China. It can be seen that in 2012, 104.445 out of 360.154 both loaded and empty TEU (102.892 out of 354.799 loaded TEU) were imported in transit from this port, which represents a 29% of the total. This percentage agrees with a research carried out by ITMMA, “Economic Analysis of the European Seaport System” (2009), where the rate of transhipment from Le Havre is fixed at 29%.

But in Le Havre inland waterway transport also plays an important role. As seen in Figure 48, in 2007, a 9% of the number of TEU imported from Le Havre and not transshipped was distributed to the hinterland through inland waterways. From this table the influence of inland waterways in other north European ports can also be seen, and it is proven that the percentages given for Antwerp, Zeebrugge, Bremerhaven, Hamburg and Rotterdam are approximately the same as the ones found for each of these ports from their Port Authority. Therefore, and although the data of Figure 48 is from 2007, it can be assumed that the influence of inland waterways in Le Havre might not have changed significantly in the past six years.

If we suppose that this percentage can be extrapolated to the case of imports from Le Havre coming from mainland China, then 23.050 out of 360.154 both loaded and empty TEU (22.707 out of 354.799 loaded TEU) were imported and distributed to the hinterland through inland waterways, which represents a 6,4% of the total.

	Road		Rail		Inland shipping		Total
Inland terminals							
Germany							
Duisburg	893,000	50%	531,000	29%	370,000	21%	1,794,000
Neuss- Dusseldorf	399,134	54%	192,148	26%	147,718	20%	739,000
Nuremberg	127,732	52%	115,950	48%	0	0%	243,682
France							
Lyon	68,687	47%	18,391	13%	57,567	40%	144,645
Mulhouse/Ottmarsheim	50,597	42%	15,028	13%	53,893	45%	119,518
Paris	197,800	68%	2,200	1%	90,000	31%	290,000
Strassbourg	153,038	59%	26,185	10%	79,836	31%	259,059
Austria							
Linz/Donau	102,199	47%	112,646	52%	2,879	1%	217,724
Enns	93,793	52%	84,425	47%	996	1%	179,214
Vienna*	322,881	100%	322,881	100%	543	0%	323,424
Sea port terminals							
Belgium							
Antwerp	4,784,000	60%	640,000	8%	2,576,000	32%	8,000,000
Zeebrugge	1,105,335	55%	903,263	44%	12,124	1%	2,020,723
France							
Dunkirk**	181,280	88%	16,480	8%	8,240	4%	206,000
Le Havre	1,864,800	84%	155,400	7%	199,800	9%	2,220,000
Marseille	771,946	82%	112,968	12%	56,484	6%	941,398
Germany							
Bremerhaven	1,800,344	37%	2,876,637	59%	215,259	4%	4,892,239
Hamburg	6,507,483	66%	3,214,182	32%	168,126	2%	9,889,792
Poland							
Szczecin	52,337	93%	3,377	6%	563	1%	56,276
Romania							
Constance**	493,644	48%	490,533	47%	52,890	5%	1,037,068
The Netherlands							
Amsterdam	193,118	50%	27,037	7%	166,081	43%	386,236
Rotterdam**	5,760,000	60%	864,000	9%	2,976,000	31%	9,600,000

* Road and rail transport are seized together
** Figures of 2006

Unit: Number of TEUs
Source: Schiffahrt Hafen Bahn und Technik 2008

Figure 48. Modal split of a few large intermodal container terminals in northwest Europe (2007) (*source: Schilfahrt Hafen Bahn und Technik, 2008*)

2.1.10. Southampton

The Port of Southampton is a major passenger and cargo port located in the central part of the south coast of England. It benefits from a sheltered location, unique “double tides”, close proximity to the motorway network and good rail links. Owned and operated by Associated British Ports since 1982, the port is the busiest cruise terminal and second largest container port in the UK.

The port is located 16 km inland, between the confluence of the rivers Test and Itchen and the head of the mile wide inlet (technically a drowned valley), known as Southampton Water. The mouth of the inlet is protected from the effects of foul weather by the mass of the Isle of Wight, which gives the port an advantageous sheltered location. Additional advantages include a densely populated hinterland and close proximity to London, and excellent rail and road links to the rest of Britain which, however, bypass the congestion of London.

The average tidal range is approximately 1,5 m, with 17 hours per day of rising water thanks to the port's "double tides". These allow the largest container and cruise ships access to the port for up to 80 per cent of the time, according to the container terminal operator DP World Southampton.

The very modern and well-equipped container terminal of Southampton is operated by DP World Southampton. The container port has 85 ha of land – not counting the 152 ha in the older Western Docks – available for port operations. Loading and unloading operations can be performed simultaneously on four large deep-sea container ships, plus one smaller ship 150 m in length.

This makes it the country's second largest such terminal, after that at Felixstowe. Southampton handles most of the trade from the Far East. The railway line from Southampton has recently been upgraded to a loading gauge of W10 on the route between the container port and the ABP terminal in Birmingham, where it links with lines that have already received this treatment. This allows the railway line to handle the taller containers now in widespread use.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Southampton from the year 2000 until the second semester of 2013 is shown in Figure 49, together with the influence of mainland China as its trade partner. The total amount of both loaded and empty TEU transported from Southampton has been fluctuating between 200 and 400 thousand TEU quarterly, with a significant peak in 2007 in which it reached more than 500 thousand TEU. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Southampton has increased significantly since 2000, becoming in the last four years around half of the total throughput of TEU from the port.

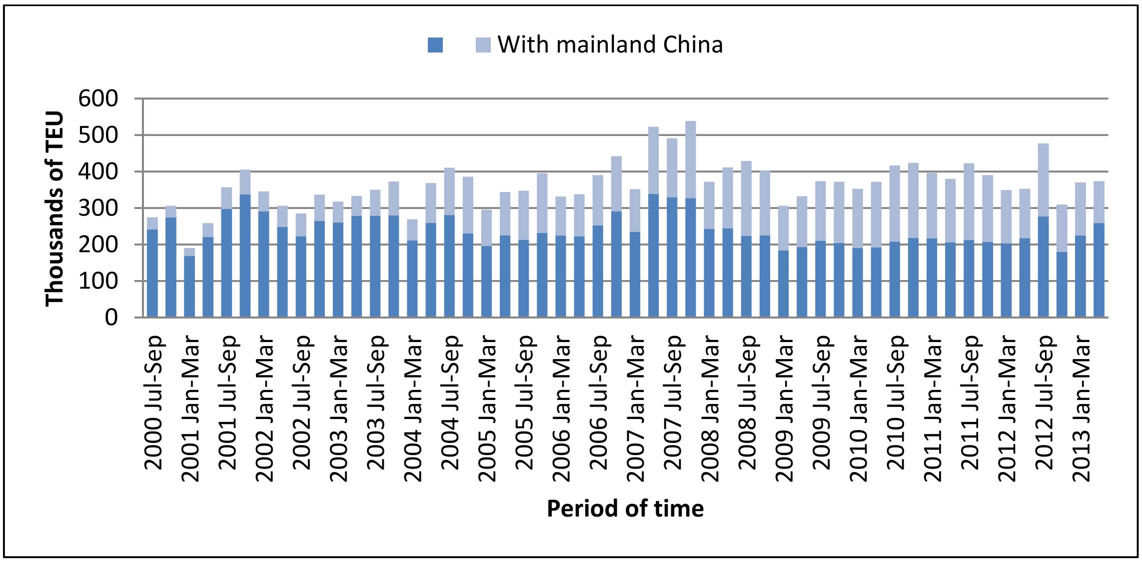


Figure 49. Total maritime transport of both loaded and empty TEU from Southampton (*source: own-source using Eurostat data*)

The total number of TEU transported from Southampton and from Southampton with mainland China is reported here. Although the imports in transit from Southampton and its use of inland waterways were tried to be reported, the Port Authority of Southampton did not provide us this information, regarding their confidential policies concerning sensitive data. The rate of empty TEU transported to and from Southampton has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 66. Number of both loaded and empty TEU transported from Southampton (*source: own-source using Port Authority of Southampton data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	725.561	914.749	785.228	666.368	767.139	786.681	**740.465**
Total import	776.691	990.437	831.558	718.302	799.411	803.839	**748.803**

Table 67. Number of loaded TEU transported from Southampton (*source: own-source using Port Authority of Southampton data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	300.609	365.647	289.800	349.910	356.686	367.067	**338.512**
Total import	754.450	963.768	806.269	684.384	762.905	751.268	**710.406**

Table 68. Percentage of empty TEU with respect to the total number of TEU transported from Southampton (*source: own-source using Port Authority of Southampton data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	59	60	63	47	54	53	**54**
Total import	3	3	3	5	5	7	**5**

Table 69. Number of both loaded and empty TEU transported from Southampton with mainland China (*source: own-source using Port Authority of Southampton data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	237.080	318.471	342.583	248.681	363.138	342.326	**252.778**
Total import	273.973	355.055	336.052	343.135	394.046	405.063	**357.745**

Table 70. Number of loaded TEU transported from Southampton with mainland China (*source: own-source using Port Authority of Southampton data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	34.075	65.445	49.296	68.879	77.614	68.975	**42.694**
Total import	269.989	349.761	329.833	339.312	391.290	393.590	**351.939**

Table 71. Percentage of empty TEU with respect to the total number of TEU transported from Southampton with mainland China (*source: own-source using Port Authority of Southampton data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	86	79	86	72	79	80	**83**
Total import	1	1	2	1	1	3	**2**

The total movement of both loaded and empty TEU from Southampton in 2012 was 1.489.268 TEU units, from which 748.803 were imported and 740.465 were exported. However, the real maritime transport of goods in containers from Southampton is given by Table 67, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Southampton in 2012 was 1.048.918 TEU units, from which 710.406 were imported and 338.512 were exported. The percentage of imported empty TEU with respect to the total number of TEU imported from Southampton (5%) is very low compared to the percentage of exported empty ones (54%). These two values show that Southampton is currently an importer port rather than an exporter one. This is due to the big existing market to serve in England, and on the other hand the neither producing nor industrial role of England in the exportation of goods.

With mainland China the total movement of both loaded and empty TEU from Southampton in 2012 was 610.523 TEU units, from which 357.745 were imported and 252.778 were exported. However, the real maritime transport of goods in containers from Southampton with mainland China is given by Table 70, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Southampton with mainland China in 2012 was 394.633 TEU units, from which 351.939 were imported and 42.694 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Southampton with mainland China is 2% for imports and 83% for exports. These values show that almost all the containers imported from Southampton coming from mainland China are loaded, while more than an 80% of the exported ones from Southampton to mainland China are empty, proving the predominant unidirectional way of the trade between these two countries.

Unfortunately, information about the imports in transit TEU and the usage of inland waterways from Port of Southampton when the commercial partner is mainland China was not available. From all the sources of information checked, the data found was empty or not reliable. Moreover, Port Authority of Southampton did not provide such information due to confidential reasons, adducing that such information is sensitive.

However, it can be supposed that the transhipment rate of Southampton will be similar to that of the Northern European ports located in the same area (Le Havre, Zeebrugge, Antwerp, etc.), and that the port will serve both the Baltic sea area, the Northern Europe area and also some ports in Southern Europe. On the other side, it also can be assumed that the rate of usage of inland waterways will not be significant, as the inland waterways from Southampton are not well prepared for the transport of containerized goods.

2.1.11. Ambarli

The Port of Ambarli is the biggest port in Turkey, and currently is the 48th biggest container port in the world by annual 2,7 million TEU. Ambarli covers a large hinterland with 20 million city dweller. Whereas Ankara is Turkish capital city, industrial and trade capital has always been Istanbul.

Turkey is an upper middle-income country, a member of the OECD, a regional power, a bridge between East and West. Turkey's economy is among the world's 16 largest, with a GDP of around USD 1.189 billion. It is a dynamic emerging-market economy strategically located between Europe and Asia, bordering the Mediterranean, Aegean and Black Seas. So that Turkey is able to control region's trade ways.

Istanbul is strategically located at the east bound gate for speedy developing Black Sea countries. Rich oil and natural gas reserves finance rapid growth of Black Sea countries so sea transportation has key importance in commercial activities. Ambarli is situated just before Bosphorus that is passage to Black Sea.

Thanks to intermodal transfers, Black Sea offers transportation facilities not only coastal countries but also inland countries. As all these factors are taken into consideration, being on the route to Black Sea Istanbul appears to be transhipment centre as well as exporting and importing hub.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Ambarli from the year 2000 until the second semester of 2011 is shown in Figure 50, together with the influence of mainland China as its trade partner. There is only data available from 2010 to 2013 for this port. In this period 2010-2013 the amount of both loaded and empty TEU transported from Ambarli has increased gradually from 500 thousand TEU quarterly to more than 800 thousand TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Ambarli has increased significantly since 2010.

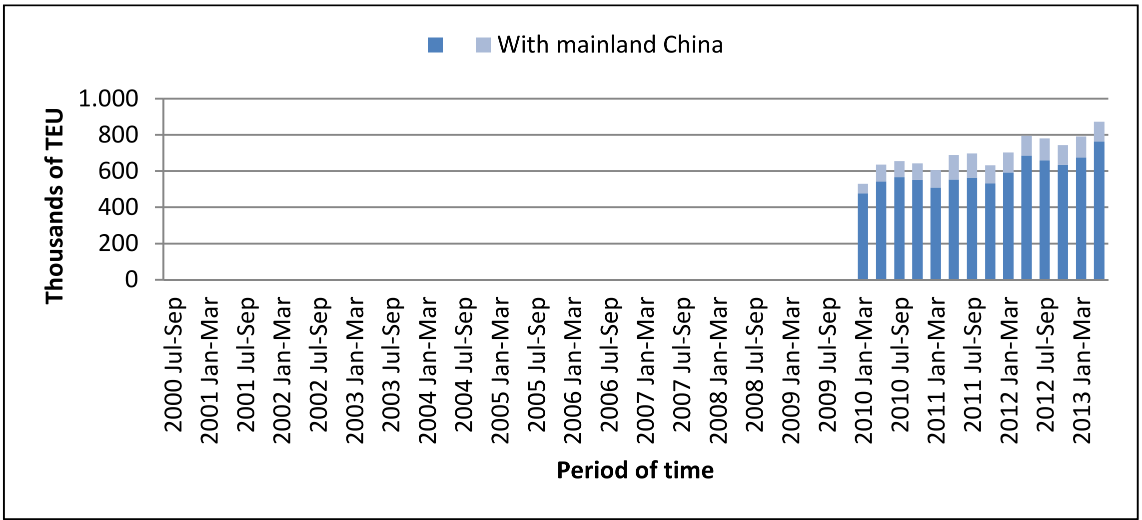


Figure 50. Total maritime transport of both loaded and empty TEU from Ambarli (*source: own-source using Eurostat data*)

The total number of TEU transported from Ambarli and from Ambarli with mainland China is reported here. Although the imports in transit from Ambarli was tried to be reported, the Port Authority of Ambarli did not provide us this information, regarding their confidential policies concerning sensitive data. The rate of empty TEU transported to and from Ambarli has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 72. Number of both loaded and empty TEU transported from Ambarli (*source: own-source using Port Authority of Ambarli data*)

	2010	2011	**2012**
Total export	1.209.736	1.286.229	**1.496.650**
Total import	1.254.130	1.338.483	**1.527.312**

Table 73. Number of loaded TEU transported from Ambarli (*source: own-source using Port Authority of Ambarli data*)

	2010	2011	**2012**
Total export	1.209.736	1.286.229	**1.104.702**
Total import	1.254.130	1.338.483	**1.256.006**

Table 74. Percentage of empty TEU with respect to the total number of TEU transported from Ambarli (*source: own-source using Port Authority of Ambarli data*)

	2010	2011	**2012**
Total export	0	0	**26**
Total import	0	0	**18**

Table 75. Number of both loaded and empty TEU transported from Ambarli with mainland China (*source: own-source using Port Authority of Ambarli data*)

	2010	2011	**2012**
Total export	123.982	196.693	**204.777**
Total import	201.605	268.627	**250.390**

Table 76. Number of loaded TEU transported from Ambarli with mainland China (*source: own-source using Port Authority of Ambarli data*)

	2010	2011	**2012**
Total export	123.982	196.693	**70.027**
Total import	201.605	268.627	**244.727**

Table 77. Percentage of empty TEU with respect to the total number of TEU transported from Ambarli with mainland China (*source: own-source using Port Authority of Ambarli data*)

	2010	2011	**2012**
Total export	0	0	**66**
Total import	0	0	**2**

The total movement of both loaded and empty TEU from Ambarli in 2012 was 3.023.962 TEU units, from which 1.527.312 were imported and 1.496.650 were exported. However, the real maritime transport of goods in containers from Ambarli is given by Table 73, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Ambarli in 2012 was 2.360.708 TEU units, from which 1.256.006 were imported and 1.104.702 were exported. The percentage of imported empty TEU with respect to the total number of TEU imported from Ambarli (18%) is similar to the exported empty ones (26%). In other words, a 26% of TEU exported from Ambarli in 2012 were empty, while an 18% of the imported ones were empty.

With mainland China the total movement of both loaded and empty TEU from Ambarli in 2012 was 455.167 TEU units, from which 250.390 were imported and 204.777 were exported. However, the real maritime transport of goods in containers from Ambarli with mainland China is given by Table 76, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Ambarli with mainland China in 2012 was 314.754 TEU units, from which 244.727 were imported and 70.027 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Ambarli with mainland China is 2% for imports and 66% for exports. These values contrast with the previous ones of Ambarli with the rest of the World. They show that almost all the containers imported from Ambarli coming from mainland China are loaded, but more than half of the exported ones from Ambarli to mainland China are empty, proving the predominant unidirectional way of the trade between these two countries.

Unfortunately, information about the imports in transit TEU from Port of Ambarli when the commercial partner is mainland China was not available. From all the sources of information checked, the data found was empty or not reliable. Moreover, Port Authority of Ambarli did not provide such information due to confidential reasons, adducing that such information is sensitive.

However, it can be supposed that the transhipment rate of Ambarli will be relatively high, as its position between the Mediterranean and the Black Seas suggests that it is in an ideal position to serve the Black Sea market. This hypothesis will be confirmed in the next chapter with the perspective of the carriers: the ones operating in Ambarli show the high rate of transhipment of this port.

2.1.12. Piraeus

The Port of Piraeus, as the largest Greek seaport, is one of the largest seaports in the Mediterranean Sea basin and one of the top ten container ports in Europe. The port is also a major employer in the area, with more than 1.500 employees who provide services to more than 24.000 ships every year. Port of Piraeus has been the port of Athens since Archaic times.

The container terminal of Piraeus has a storage of 900.000 m^2 and an annual traffic capacity of around 1,8 million TEU. The container terminal has two piers with a total length of 2,8 km, a storage area of 626.000 m^2 and an annual capacity of 1,6-1,8 million TEU. Apart from Pier I and II, there are plans to build another pier, Pier III, which at completion in 2015 will have a high density stacking system with a container capacity of 1.000.000 TEU per year.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Piraeus from the year 2000 until the second semester of 2013 is shown in Figure 51, together with the influence of mainland China as its trade partner. This port is the one which has experienced a faster growth in the last 5 years, increasing from less than 0,1 million TEU quarterly in 2008 to more than 0,7 million TEU quarterly in 2013, a value that is much higher to the one previous to the European economic crisis in 2008 (from the year 2000 to the year 2008 the maritime transport of both loaded and empty TEU from Piraeus was stable at 0,4 million

TEU). In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Piraeus has increased significantly since 2000.

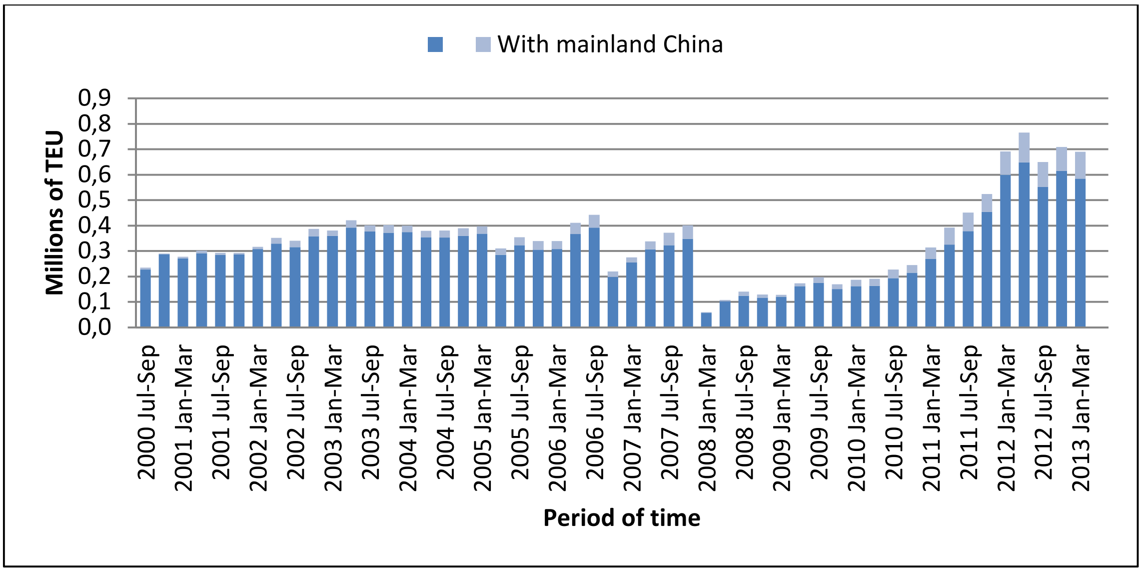


Figure 51. Total maritime transport of both loaded and empty TEU from Piraeus (*source: own-source using Eurostat data*)

The total number of TEU transported from Piraeus and from Piraeus with mainland China is reported here. As for this specific study, also the imports in transit from Piraeus have been recorded thanks to the Port Authority of Piraeus. The rate of empty TEU transported to and from Piraeus has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 78. Number of both loaded and empty TEU transported from Piraeus (*source: own-source using Port Authority of Piraeus data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	691.878	692.229	207.644	341.159	420.599	822.506	**1.397.395**
Total import	720.676	691.602	229.657	325.976	429.655	858.371	**1.417.669**
Import in transit (90% total import)	648.608	622.442	206.691	293.378	386.690	772.534	**1.275.902**

Table 79. Number of loaded TEU transported from Piraeus (*source: own-source using Port Authority of Piraeus data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	456.058	354.189	64.189	147.015	245.379	614.375	**1.078.602**
Total import	687.933	655.033	225.570	315.450	409.476	776.976	**1.199.529**
Import in transit (90% total import)	619.140	589.530	203.013	283.905	368.528	699.278	**1.079.576**

Table 80. Percentage of empty TEU with respect to the total number of TEU transported from Piraeus (*source: own-source using Port Authority of Piraeus data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	34	49	69	57	42	25	**23**
Total import	5	5	2	3	5	9	**15**

Table 81. Number of both loaded and empty TEU transported from Piraeus with mainland China (*source: own-source using Port Authority of Piraeus data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	27.798	54.593	6.359	12.464	31.817	87.006	**164.686**
Total import	120.125	97.462	29.354	46.802	85.718	167.822	**235.390**
Import in transit (90% total import)	108.113	87.716	26.419	42.122	77.146	151.040	**211.851**

Table 82. Number of loaded TEU transported from Piraeus with mainland China (*source: own-source using Port Authority of Piraeus data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	17.325	23.523	1.283	4.195	13.200	72.771	**118.110**
Total import	120.081	96.734	29.354	46.802	85.449	167.805	**233.868**
Import in transit (90% total import)	108.073	87.061	26.419	42.122	76.904	151.025	**210.481**

Table 83. Percentage of empty TEU with respect to the total number of TEU transported from Piraeus with mainland China (*source: own-source using Port Authority of Piraeus data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	38	57	80	66	59	16	**28**
Total import	0	1	0	0	0	0	**1**

The total movement of both loaded and empty TEU from Piraeus in 2012 was 2.815.064 TEU units, from which 1.417.669 were imported and 1.397.395 were exported. However, the real maritime transport of goods in containers from Piraeus is given by Table 79, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Piraeus in 2012 was 2.278.131 TEU units, from which 1.199.529 were imported and 1.078.602 were exported. The percentage of imported empty TEU with respect to the total number of TEU imported from Piraeus (15%) is lower than the exported empty ones (23%). In other words, a 23% of TEU exported from Piraeus in 2012 were empty, while a 15% of the imported ones were empty.

With mainland China the total movement of both loaded and empty TEU from Piraeus in 2012 was 400.076 TEU units, from which 235.390 were imported and 164.686 were exported. However, the real maritime transport of goods in containers from Piraeus with mainland China is given by Table 82, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Piraeus with mainland China in 2012 was 351.978 TEU units, from which 233.868 were imported and 118.110 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Piraeus with mainland China is 1% for imports and 28% for exports. These values contrast with the previous ones of Piraeus with the rest of the World.

Moreover, Table 81 and Table 82 include information about the import in transit TEU from Port of Piraeus when the commercial partner is mainland China. It can be seen that in 2012, 211.851 out of 235.390 both loaded and empty TEU (210.481 out of 233.868 loaded TEU) were imported in transit from this port, which represents a 90% of the total, showing the big role that Piraeus plays as a transhipment port.

2.1.13. Antwerp

The Port of Antwerp, in Belgium, is a port in the heart of Europe accessible to capsize ships. Antwerp stands at the upper end of the tidal estuary of the Scheldt. The estuary is navigable by ships of more than 100.000 gross tons as far as 80 km inland.

The inland location means that the port of Antwerp enjoys a more central location in Europe than the majority of North Sea ports. Antwerp's docks are connected to the hinterland by rail, waterway and road. As a result the port of Antwerp has become one of Europe's largest sea ports, ranking second behind Rotterdam by total freight shipped. Its international rankings vary from 11th to 20th (AAPA).

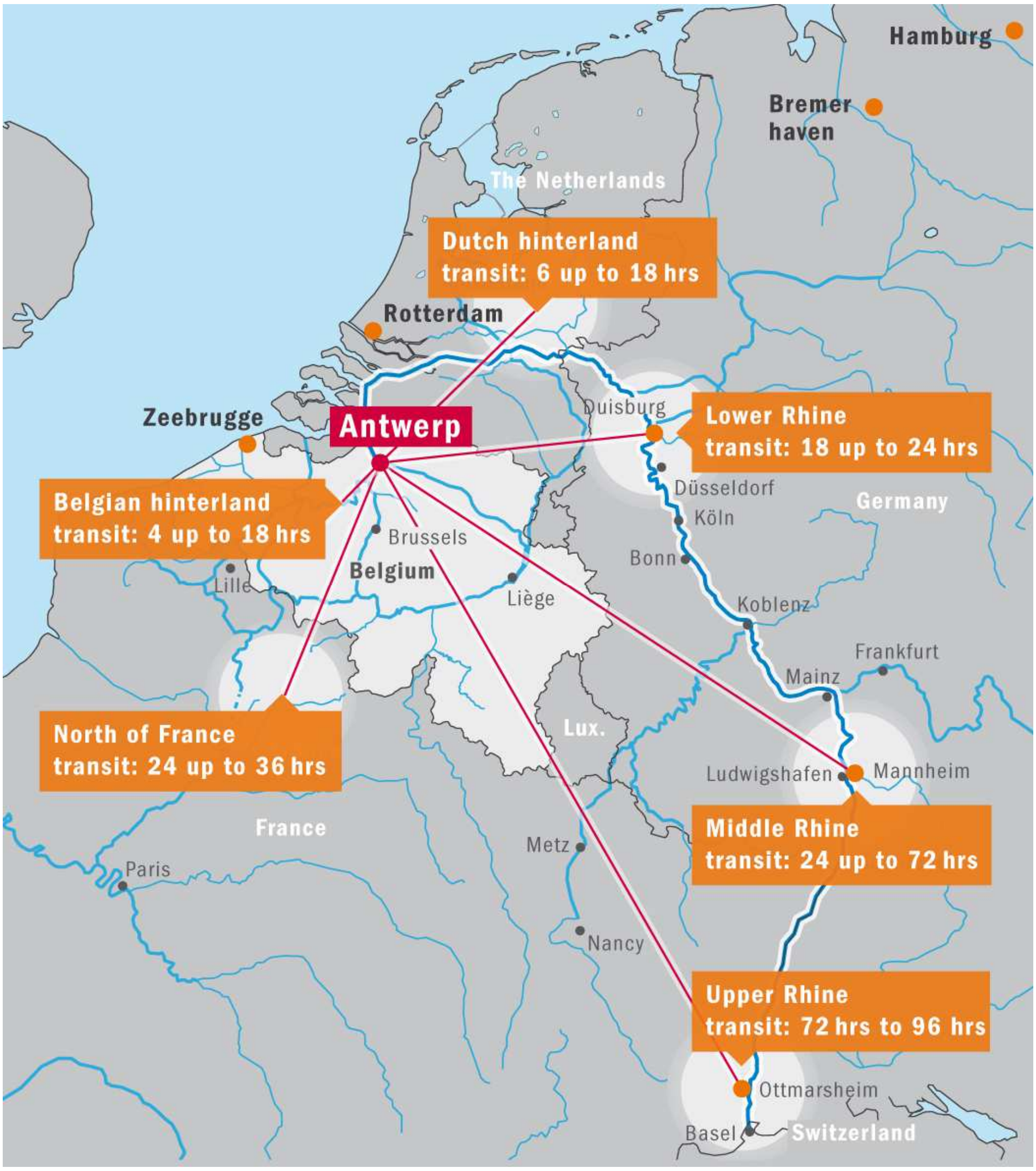


Figure 52. Time distance from the Port of Antwerp to different locations in its hinterland (*source: Port Authority of Antwerp*)

In 2012, the Port of Antwerp handled 14.220 sea trade ships (190,8 million tons of cargo, 53,6% in containers), 57.044 inland barges (123,2 million tons of cargo), and offered liner services to 800 different maritime destinations.

In October 2010, the port approved a long-term investment plan, worth 1,6 billion euros over the next 15 years. The port would improve existing facilities, and buy land from General Motors, which is closing its Antwerp factory.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Antwerp from the year 2000 until the second semester of 2013 is shown in Figure 53, together with the influence of mainland China as its trade partner. Between the first quarter of 2003 and the first quarter of 2008 there was a big increase in the maritime transport of both loaded and empty TEU from Antwerp (from less than 1 million TEU quarterly to more than 2 million TEU quarterly). However, in 2008, when the European crisis started, there was a drop down followed by a stabilisation of the total maritime transport of TEU at about 2 million per quarter. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Antwerp has increased significantly since 2000.

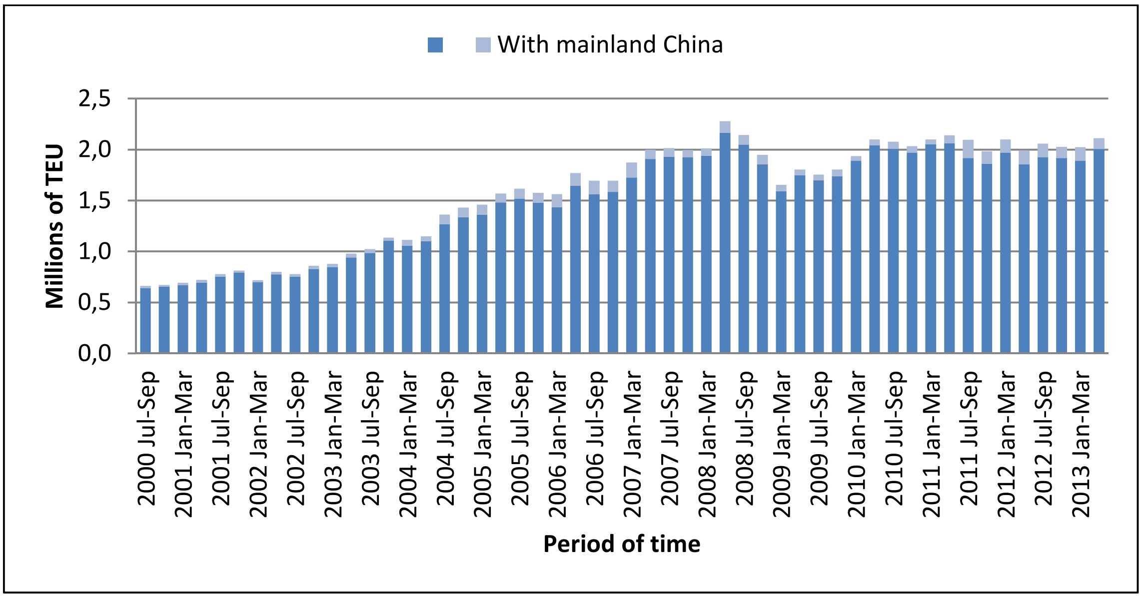


Figure 53. Total maritime transport of both loaded and empty TEU from Antwerpen (*source: own-source using Eurostat data*)

The total number of TEU transported from Antwerp and from Antwerp with mainland China is reported here. As for this specific study, also the imports in transit from Antwerp and its use of inland waterways have been recorded thanks to the Port Authority of Antwerp. The rate of empty TEU transported to and from Antwerp has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 84. Number of both loaded and empty TEU transported from Antwerp (*source: own-source using Port Authority of Antwerp data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	3.405.005	4.017.639	4.296.189	3.523.231	4.202.590	4.282.517	**4.168.417**
Total import	3.313.193	3.861.282	4.082.666	3.491.110	3.941.781	4.034.259	**4.005.958**
Import in transit excluding IW (20% total import)	662.639	772.256	816.533	698.222	788.356	806.852	**801.192**

IW (34*80=27,2% total import)	901.188	1.050.269	1.110.485	949.582	1.072.164	1.097.318	**1.089.621**

Table 85. Number of loaded TEU transported from Antwerp (*source: own-source using Port Authority of Antwerp data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	3.152.642	3.573.235	3.844.614	3.265.950	3.858.653	3.977.661	**3.967.301**
Total import	2.561.490	3.080.431	3.286.356	2.714.296	3.166.018	3.307.960	**3.158.925**
Import in transit excluding IW (20% total import)	512.298	616.086	657.271	542.859	633.204	661.592	**631.785**
IW (34*80=27,2% total import)	696.725	837.877	893.889	738.289	861.157	899.765	**859.228**

Table 86. Percentage of empty TEU with respect to the total number of TEU transported from Antwerp (*source: own-source using Port Authority of Antwerp data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	7	11	11	7	8	7	**5**
Total import	23	20	20	22	20	18	**21**

Table 87. Number of both loaded and empty TEU transported from Antwerp with mainland China (*source: own-source using Port Authority of Antwerp data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	290.992	242.074	218.927	140.063	153.866	228.594	**276.336**
Total import	203.984	151.510	155.565	99.557	81.201	199.448	**233.073**
Import in transit excluding IW (20% total import)	40.797	30.302	31.113	19.911	16.240	39.890	**46.615**
IW (34*80=27,2% total import)	55.484	41.211	42.314	27.080	22.087	54.250	**63.396**

Table 88. Number of loaded TEU transported from Antwerp with mainland China (*source: own-source using Port Authority of Antwerp data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	219.678	166.561	156.948	114.056	121.178	189.192	**243.234**
Total import	161.773	139.111	148.302	91.317	74.582	183.350	**201.096**
Import in transit excluding IW (20% total import)	32.355	27.822	29.660	18.263	14.916	36.670	**40.219**
IW (34*80=27,2% total import)	44.002	37.838	40.338	24.838	20.286	49.871	**54.698**

Table 89. Percentage of empty TEU with respect to the total number of TEU transported from Antwerp with mainland China (*source: own-source using Port Authority of Antwerp data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	25	31	28	19	21	17	**12**
Total import	21	8	5	8	8	8	**14**

The total movement of both loaded and empty TEU from Antwerp in 2012 was 8.174.375 TEU units, from which 4.005.958 were imported and 4.168.417 were exported. However, the real maritime transport of goods in containers from Antwerp is given by Table 85, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Antwerp in 2012 was 7.126.226 TEU units, from which 3.158.925 were imported and 3.967.301 were exported. The percentage of imported empty TEU with respect to the total number of TEU imported from Antwerp (21%) is much higher than the exported empty ones (5%). In other words, a 5% of TEU exported from Antwerp in 2012 were empty, while a 21% of the imported ones were empty. These values show that in the case of Antwerp the exportation plays a more important role than the importation.

With mainland China the total movement of both loaded and empty TEU from Antwerp in 2012 was 509.409 TEU units, from which 233.073 were imported and 276.336 were exported. However, the real maritime transport of goods in containers from Antwerp with mainland China is given by Table 88, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Antwerp with mainland China in 2012 was 444.330 TEU units, from which 201.096 were imported and 243.234 were exported.

The percentage of empty TEU with respect to the total number of TEU transported from Antwerp with mainland China is 14% for imports and 12% for exports. These values contrast with the previous ones of Antwerp with the rest of the World. They show that concerning the trade with mainland China, the percentage of empty TEU in the imports is similar to that in the exports.

Moreover, Table 87 and Table 88 include information about the import in transit TEU from Port of Antwerp when the commercial partner is mainland China. It can be seen that in 2012, 46.615 out of 233.073 both loaded and empty TEU (40.219 out of 201.096 loaded TEU) were imported in transit from this port, which represents a 20% of the total. This percentage agrees with a research carried out by ITMMA, "Economic Analysis of the European Seaport System" (2009), where the rate of transhipment from Antwerp is fixed at 20%.

But in Antwerp inland waterway transport also plays an important role. As seen in Figure 48, in 2007, a 32% of the number of TEU imported from Antwerp and not transshipped was distributed to the hinterland through inland waterways. This value is very similar to the one given by Port of Antwerp, which is fixed at 34% (Figure 54).

If we assume that this percentage can be extrapolated to the case of imports from Antwerp coming from China, then 63.396 out of 233.073 both loaded and empty TEU (54.698 out of 201.096 loaded TEU) were imported and distributed to the hinterland through inland waterways, which represents a 27,2% of the total.

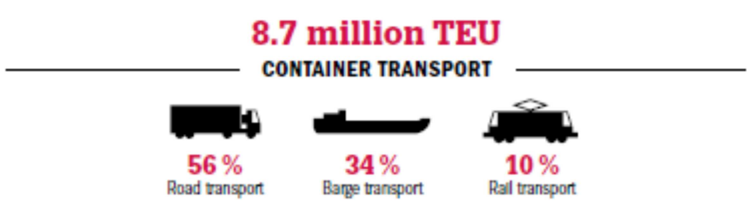


Figure 54. Modal split of the hinterland traffic in Antwerp (*source: Port Authority of Antwerp*)

From all the sources of information checked, the data concerning the final destination of the imports in transit coming from mainland China was not available. However, after discussing with some of the Port of Antwerp representatives in China, it was stated that the main final destinations for the imports in transit are the Baltic Sea and the United Kingdom, and in a lower degree South Europe and Transoceanic routes (Figure 55).

Figure 55. Main final transhipment destinations from the Port of Antwerp (*source: Port Authority of Antwerp*)

2.1.14. Marseille

Marseille Fos port, officially named in French *Grand Port Maritime de Marseille* (Great Seaport of Marseille), is the main French trade seaport. In 2011 the port had an overall traffic of 88 million tons. The port generates 45,000 jobs and 4 billion euros of value added according to an OECD study.

The container terminal of Marseille has a storage of 900.000 m^2 and an annual traffic capacity of around 1,8 million TEU. The container terminal has two piers with a total length of 2,8 km, a storage area of 626.000 m^2 and an annual capacity of 1,6-1,8 million TEU. Apart from Pier I and II, there are plans to build another pier, Pier III, which at completion in 2015 will have a high density stacking system with a container capacity of 1.000.000 TEU per year.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Marseille from the year 2000 until the second semester of 2011 is shown in Figure 56, together with the influence of mainland China as its trade partner. The amount of both loaded and empty TEU transported from the port has remained more or less constant in this period, only having a drastic drop down in 2008 from 270 thousand TEU quarterly to 160, but after recovering fast and keeping constant at around 300 thousand TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Marseille has increased significantly since 2000.

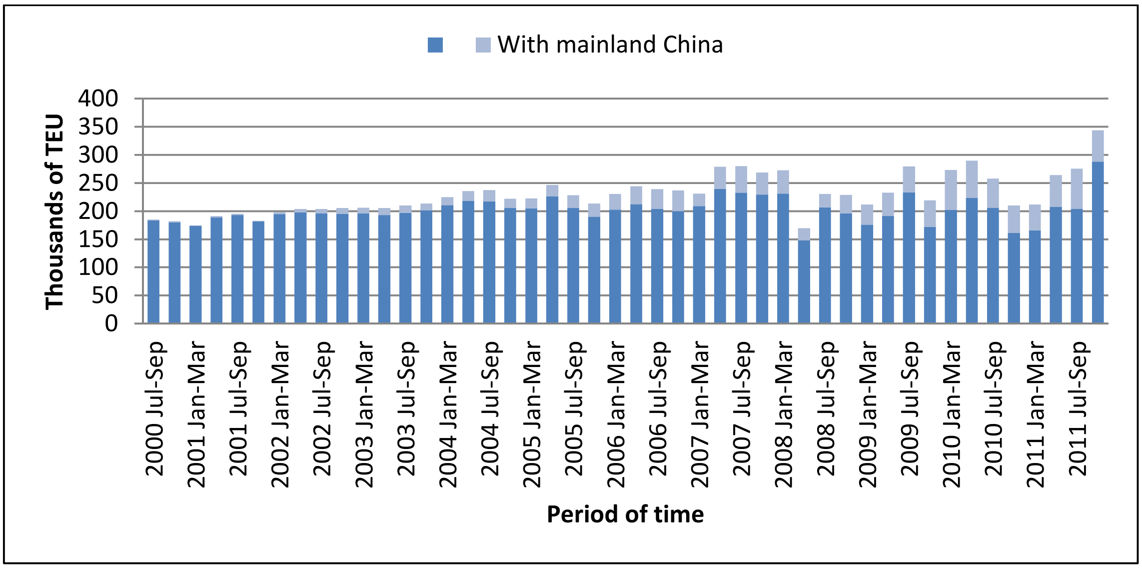


Figure 56. Total maritime transport of both loaded and empty TEU from Marseille (*source: own-source using Eurostat data*)

The total number of TEU transported from Marseille and from Marseille with mainland China is reported here. As for this specific study, also the imports in transit from Marseille and its use of inland waterways have been recorded. The rate of empty TEU transported to and from Marseille has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 90. Number of both loaded and empty TEU transported from Marseille (*source: own-source using Port Authority of Marseille data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	463.434	479.697	415.675	428.961	463.780	468.358	**541.183**
Total import	486.762	578.775	485.736	514.283	567.158	626.861	**614.151**
Import in transit (4% total import)	19.470	23.151	19.429	20.571	22.686	25.074	**24.566**
IW (6*96=5,76% total import)	28.037	33.337	27.978	29.623	32.668	36.107	**35.375**

Table 91. Number of loaded TEU transported from Marseille (*source: own-source using Port Authority of Marseille data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	425.029	440.039	375.997	407.013	411.632	418.636	**488.504**
Total import	365.452	469.522	383.000	401.139	470.540	533.436	**562.895**
Import in transit (4% total import)	14.618	18.781	15.320	16.046	18.822	21.337	**22.516**

IW (6*96=5,76% total import)	21.050	27.044	22.061	23.106	27.103	30.726	**32.423**

Table 92. Percentage of empty TEU with respect to the total number of TEU transported from Marseille (*source: own-source using Port Authority of Marseille data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	8	8	10	5	11	11	**10**
Total import	25	19	21	22	17	15	**8**

Table 93. Number of both loaded and empty TEU transported from Marseille with mainland China (*source: own-source using Port Authority of Marseille data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	19.906	27.233	19.246	38.781	38.721	43.991	**52.553**
Total import	111.113	120.472	100.927	132.028	199.205	186.301	**205.670**
Import in transit (4% total import)	4.445	4.819	4.037	5.281	7.968	7.452	**8.227**
IW (6*96=5,76% total import)	6.400	6.939	5.813	7.605	11.474	10.731	**11.847**

Table 94. Number of loaded TEU transported from Marseille with mainland China (*source: own-source using Port Authority of Marseille data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	18.605	26.913	19.246	38.781	37.881	42.078	**50.400**
Total import	110.126	120.468	100.927	132.028	199.097	185.172	**204.427**
Import in transit (4% total import)	4.405	4.819	4.037	5.281	7.964	7.407	**8.177**
IW (6*96=5,76% total import)	6.343	6.939	5.813	7.605	11.468	10.666	**11.775**

Table 95. Percentage of empty TEU with respect to the total number of TEU transported from Marseille with mainland China (*source: own-source using Port Authority of Marseille data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	7	1	0	0	2	4	**4**
Total import	1	0	0	0	0	1	**1**

The total movement of both loaded and empty TEU from Marseille in 2012 was 1.155.334 TEU units, from which 614.151 were imported and 541.183 were exported. However, the real maritime transport of goods in containers from Marseille is given by Table 91, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Marseille in 2012 was 1.051.399 TEU units, from which 562.895 were imported and 488.504 were exported. The percentage of imported empty TEU with respect to the total number of imported TEU from Marseille (8%) is similar to the exported empty ones (10%). In other words, a 10% of TEU exported from Marseille in 2012 were empty, while an 8% of the imported ones were empty. While the percentage of exported empty TEU has been kept more or less constant during the last decade, the percentage of imported empty TEU has been decreasing from 2003 (32%) to 2012 (8%).

With mainland China the total movement of both loaded and empty TEU from Marseille in 2012 was 258.223 TEU units, from which 205.670 were imported and 52.553 were exported. However, the real maritime transport of goods in containers from Marseille with mainland China is given by Table 94, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Marseille with mainland China in 2012 was 254.827 TEU units, from which 204.427 were imported and 50.400 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Marseille with mainland China is 1% for imports and 4% for exports. These values contrast with the previous ones of Marseille with the rest of the World. They show that almost all the containers both imported and exported from Marseille to/from mainland China are loaded.

Moreover, Table 93 and Table 94 include information about the imports in transit from Port of Marseille coming from mainland China. It can be seen that in 2012, 8.227 out of 205.670 both loaded and empty TEU (8.177 out of 204.427 loaded TEU) were imported in transit from this port, which represents a 4% of the total. This percentage agrees with a research carried out by ITMMA, “Economic Analysis of the European Seaport System” (2009), where the rate of transhipment from Marseille is fixed at 4%.

But in Marseille inland waterway transport also plays an important role. As seen in Figure 48, in 2007, a 6% of the number of TEU imported from Marseille and not transshipped was distributed to the hinterland through inland waterways. Therefore, and although the data of Figure 48 is from 2007, it can be assumed that the influence of inland waterways in Marseille might not have changed significantly in the past six years.

If we suppose that this percentage can be extrapolated to the case of imports from Marseille coming from mainland China, then 11.847 out of 205.670 both loaded and empty TEU (11.775 out of 204.427 loaded TEU) were imported and distributed to the hinterland through inland waterways, which represents a 5,8% of the total.

2.1.15. Zeebrugge

The Port of Bruges-Zeebrugge is a large container, bulk cargo, new vehicles and passenger ferry terminal port in the municipality of Bruges, Flanders, Belgium, handling over 50 million tonnes of cargo annually.

In the last 20 years Zeebrugge has become a multifaceted port that handles a wide range of trades: unit loads (trailers and containers), new cars, conventional general cargo, high and heavy cargoes, dry and liquid bulk cargoes and natural gas. From a purely transit port Zeebrugge has gradually evolved into a centre for European distribution.

The port has become a major European port since major development works were carried in the 1972 to 1985 period. Since then total tonnage has doubled. As of 2008, Bruges-Zeebrugge was one of the fastest growing ports between Le Havre and Hamburg. It is Europe's leading Ro-Ro port, handling 12,5 million tonnes in 2010, and the world's largest port for imports and exports of new vehicles, with over 1,6 million units handled in 2010. It is also Europe's largest terminal for liquefied natural gas (LNG), receiving natural gas from the Troll gas field via the 814 km long Zeepipe under the North Sea. LNG is also delivered in specialized gas tankers from various origins, like Africa, Australia or the Middle East. Zeebrugge counts as one of the most important ports in Europe for containerized cargo as well, handling over 2,5 million TEU in 2010. In tonnage this comes down to 26,5 million tonnes.

The port employs directly over 11.000 people and handles over 10.000 ship moorings annually. Together with the indirect employees, the port creates over 28.000 jobs. The port of Bruges-Zeebrugge is managed by the *Maatschappij van de Brugse Zeevaartinrichtingen N.V.* (abbreviated MBZ).

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Zeebrugge from the year 2000 until the second semester of 2013 is shown in Figure 57, together with the influence of mainland China as its trade partner. Between 2000 and the end of

2009 the amount of both loaded and empty TEU transported from Zeebrugge increased gradually from 50 thousand TEU quarterly to more than 400 thousand TEU quarterly. However, since the beginning of 2010 the number of TEU transported from Zeebrugge has been decreasing and in the second quarter of 2013 it was 200 thousand TEU. It seems that the European economic recessions affected Zeebrugge later than the other European ports, but still affects it because the port keeps decreasing its quarter throughput. It must be pointed out, though, that the influence of mainland China in the total maritime transport of TEU from Zeebrugge has increased significantly since 2000.

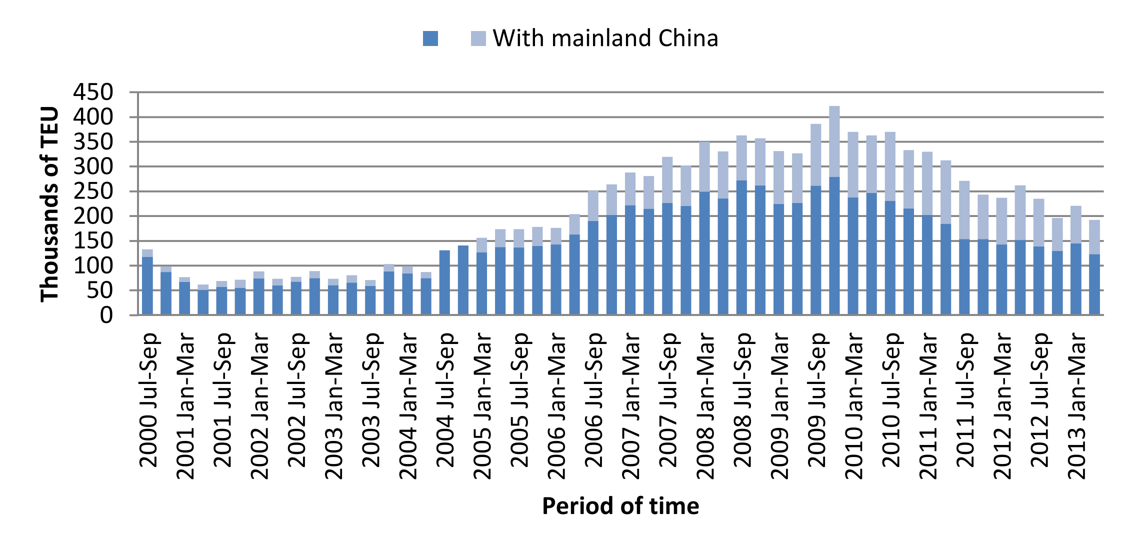


Figure 57. Total maritime transport of both loaded and empty TEU from Zeebrugge (*source: own-source using Eurostat data*)

The total number of TEU transported from Zeebrugge and from Zeebrugge with mainland China is reported here. As for this specific study, also the imports in transit from Zeebrugge and its use of inland waterways have been recorded. The rate of empty TEU transported to and from Zeebrugge has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 96. Number of both loaded and empty TEU transported from Zeebrugge (*source: own-source using Port Authority of Zeebrugge data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	485.669	611.864	705.590	726.576	722.226	546.494	**454.426**
Total import	409.819	579.106	695.249	740.329	714.533	610.920	**475.693**
Import in transit excluding IW (20% total import)	81.964	115.821	139.050	148.066	142.907	122.184	**95.139**

IW (1% total import)	4.098	5.791	6.952	7.403	7.145	6.109	**4.757**

Table 97. Number of loaded TEU transported from Zeebrugge (*source: own-source using Port Authority of Zeebrugge data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	382.812	424.332	472.172	598.993	562.478	415.600	**364.832**
Total import	294.730	410.437	476.698	596.667	610.160	505.402	**416.851**
Import in transit excluding IW (20% total import)	58.946	82.087	95.340	119.333	122.032	101.080	**83.370**
IW (1% total import)	2.947	4.104	4.767	5.967	6.102	5.054	**4.169**

Table 98. Percentage of empty TEU with respect to the total number of TEU transported from Zeebrugge (*source: own-source using Port Authority of Zeebrugge data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	21	31	33	18	22	24	**20**
Total import	28	29	31	19	15	17	**12**

Table 99. Number of both loaded and empty TEU transported from Zeebrugge with mainland China (*source: own-source using Port Authority of Zeebrugge data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	100.138	161.444	191.851	235.100	262.829	223.589	**173.692**
Total import	96.200	144.633	188.712	239.745	243.513	239.163	**193.759**
Import in transit excluding IW (20% total import)	19.240	28.927	37.742	47.949	48.703	47.833	**38.752**
IW (1% total import)	962	1.446	1.887	2.397	2.435	2.392	**1.938**

Table 100. Number of loaded TEU transported from Zeebrugge with mainland China (*source: own-source using Port Authority of Zeebrugge data*)

	2006	2007	2008	2009	2010	2011	**2012**

Total export	47.261	56.901	60.650	137.264	135.079	98.982	**95.020**
Total import	93.541	141.725	178.729	223.808	241.125	228.870	**189.972**
Import in transit excluding IW (20% total import)	18.708	28.345	35.746	44.762	48.225	45.774	**37.994**
IW (1% total import)	935	1.417	1.787	2.238	2.411	2.289	**1.900**

Table 101. Percentage of empty TEU with respect to the total number of TEU transported from Zeebrugge with mainland China (*source: own-source using Port Authority of Zeebrugge data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	53	65	68	42	49	56	**45**
Total import	3	2	5	7	1	4	**2**

The total movement of both loaded and empty TEU from Zeebrugge in 2012 was 930.119 TEU units, from which 475.693 were imported and 454.426 were exported. However, the real maritime transport of goods in containers from Zeebrugge is given by Table 97, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Zeebrugge in 2012 was 781.683 TEU units, from which 416.851 were imported and 364.832 were exported. The percentage of exported empty TEU with respect to the total number of TEU transported from Zeebrugge (20%) is higher than the imported empty ones (12%). In other words, a 20% of TEU exported from Zeebrugge in 2012 were empty, while a 12% of the imported ones were empty. While the percentage of exported empty TEU has been kept more or less constant during the last decade, the percentage of imported empty TEU has been decreasing from 2005 (30%) to 2012 (12%).

With mainland China the total movement of both loaded and empty TEU from Zeebrugge in 2012 was 367.451 TEU units, from which 193.759 were imported and 173.692 were exported. However, the real maritime transport of goods in containers from Zeebrugge with mainland China is given by Table 100, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Zeebrugge with mainland China in 2012 was 284.992 TEU units, from which 189.972 were imported and 95.020 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Zeebrugge with mainland China is 2% for imports and 45% for exports. These values show that almost all the containers imported from Zeebrugge coming from mainland China are loaded, while almost half of the exported ones (45%) are empty.

Moreover, Table 99 and Table 100 include information about the imports in transit from Port of Zeebrugge coming from mainland China. It can be seen that in 2012, 38.752 out of 193.759 both loaded and empty TEU (37.994 out of 189.972 loaded TEU) were imported in transit from this port, which represents a 20% of the total. This percentage agrees with a research carried out by ITMMA, “Economic Analysis of the European Seaport System” (2009), where the rate of transhipment from Zeebrugge is fixed at 20%.

But in Zeebrugge inland waterway transport also plays an important role. As seen in Figure 48, in 2007, 1% of the number of TEU imported from Zeebrugge was distributed to the hinterland through inland waterways. Therefore, and although the data of Figure 48 is from 2007, it can be assumed that the influence of inland waterways in Zeebrugge might not have changed significantly in the past six years.

If we suppose that this percentage can be extrapolated to the case of imports from Zeebrugge coming from mainland China, then 1.938 out of 193.759 both loaded and empty TEU (1.900 out of 189.972 loaded TEU) were imported and distributed to the hinterland through inland waterways, which represents a 1% of the total.

In Zeebrugge the port policy aims at a balanced division over the various ways of transport. The road transport is dominant, but railway transport is also well developed. Currently, Zeebrugge still lacks an adequate connection with the European inland navigation, which is temporarily compensated through the deployment of estuary ships.

The strong increase of container traffic largely determines the evolution of the modal split. In 2009 the port handled 25 million tonnes of containers (2,3 million TEU). At a rough estimate, in 2030 the Western outer port will handle about 5 million TEU. The hinterland for containers is reached by road, by railway and via navigation. The opening-up of the port of Zeebrugge via the various transport modes is important for the further sustainable development of the region of Bruges as a logistic turntable.

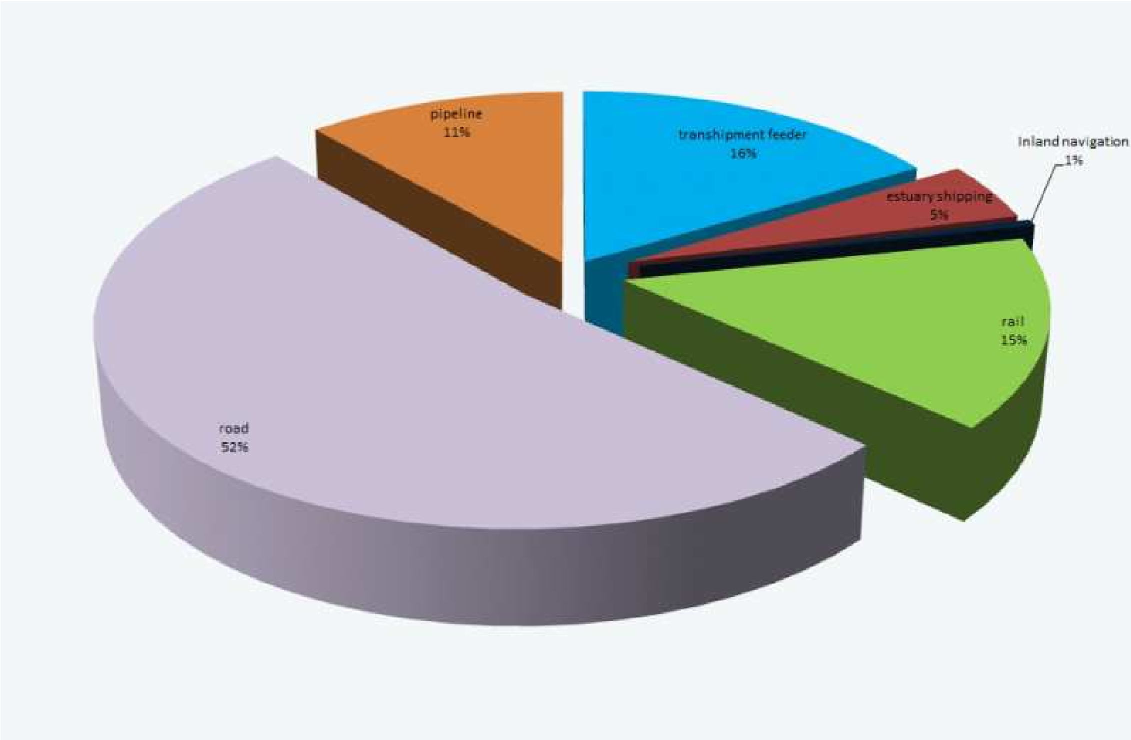


Figure 58. Modal split of the hinterland traffic of Port of Zeebrugge (*source: Port Authority of Zeebrugge*)

2.1.16. Gdansk

The Port of Gdansk is a seaport located on the southern coast of Gdansk Bay in the city of Gdansk (Poland), extending along the Vistula estuary Martwa Wisla (Dead Vistula), Port Channel and Kashubia Canal.

The Gdansk port is a major international transportation hub situated in the central part of the southern Baltic coast, which ranks among Europe's fastest growing regions. According to the strategy of European Union the Port of Gdansk plays a significant role as a key link in the Trans-European Transport Corridor No. 6 connecting the Nordic countries with Southern and Eastern Europe.

The Port of Gdansk is comprised of two principal sections with naturally diverse operational parameters: the inner port stretched along the Dead Vistula and the port canal, and the outer port affording direct access to the Gulf of Gdansk.

The inner port offers a comprehensive range of terminals and facilities designed to handling containerized cargo, passenger ferries and Ro-Ro vessels, passenger cars and citrus fruit, sulphur, phosphorites and other bulk. The other quays fitted with versatile equipment and infrastructure are universal in use and enable the handling of conventional general as well as bulk cargo such as rolled steel products, oversize and heavy lifts, grain, artificial fertilizers, ore and coal.

The outer port performs its operations on piers, quays and cargo handling jetties situated immediately on the waters of the Gulf of Gdansk. This section of the port offers state-of-the-art facilities suited to handling energy raw materials such as liquid fuels, coal and liquefied gas. The outer port also accommodates modern Deepwater Container Terminal.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Gdansk from the year 2000 until the second semester of 2013 is shown in Figure 59, together with the influence of mainland China as its trade partner. There is no data available between 2000 and 2004, but from 2004 the presence of Gdansk in the European map of ports has increased exponentially from transporting almost no TEU in 2004 to more than 250 thousand TEU quarterly in 2013, and the tendency is to keep rising. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Gdansk has increased significantly since 2004.

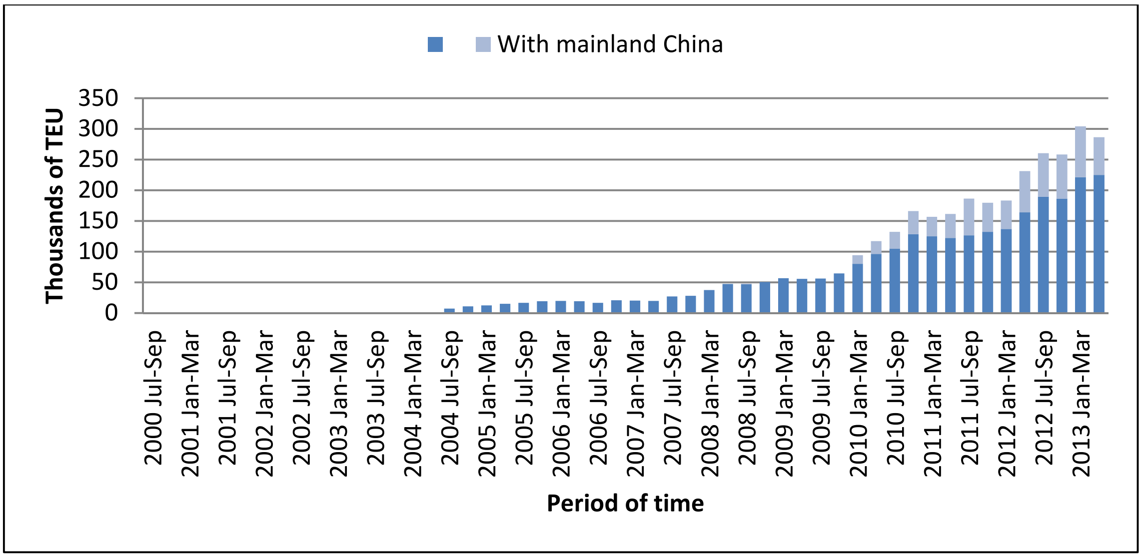


Figure 59. Total maritime transport of both loaded and empty TEU from Gdansk (*source: own-source using Eurostat data*)

The total number of TEU transported from Gdansk and from Gdansk with mainland China is reported here. Although the imports in transit from Gdansk were tried to be reported, the Port Authority of Gdansk did not provide us this information, regarding their confidential policies concerning sensitive data. The rate of empty TEU transported to and from Gdansk has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 102. Number of both loaded and empty TEU transported from Gdansk (*source: own-source using Port Authority of Gdansk data*)

	2010	2011	**2012**
Total export	272.679	352.906	**469.095**
Total import	237.208	331.806	**464.331**

IW (5% total import)	11.860	16.590	**23.217**

Table 103. Number of loaded TEU transported from Gdansk (*source: own-source using Port Authority of Gdansk data*)

	2010	2011	**2012**
Total export	223.529	235.978	**313.571**
Total import	199.114	265.308	**344.690**
IW (5% total import)	9.956	13.265	**17.235**

Table 104. Percentage of empty TEU with respect to the total number of TEU transported from Gdansk (*source: own-source using Port Authority of Gdansk data*)

	2010	2011	**2012**
Total export	18	33	**33**
Total import	16	20	**26**

Table 105. Number of both loaded and empty TEU transported from Gdansk with mainland China (*source: own-source using Port Authority of Gdansk data*)

	2010	2011	**2012**
Total export	23.591	59.872	**93.125**
Total import	76.902	118.427	**163.247**
IW (5% total import)	3.845	5.921	**8.162**

Table 106. Number of loaded TEU transported from Gdansk with mainland China (*source: own-source using Port Authority of Gdansk data*)

	2010	2011	**2012**
Total export	2.407	8.940	**13.914**
Total import	76.764	118.413	**163.247**
IW (5% total import)	3.838	5.921	**8.162**

Table 107. Percentage of empty TEU with respect to the total number of TEU transported from Gdansk with mainland China (*source: own-source using Port Authority of Gdansk data*)

	2010	2011	**2012**
Total export	90	85	**85**
Total import	0	0	**0**

The total movement of both loaded and empty TEU from Gdansk in 2012 was 933.426 TEU units, from which 464.331 were imported and 469.095 were exported. However, the real maritime transport of goods in containers from Gdansk is given by Table 103, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from

Gdansk in 2012 was 658.261 TEU units, from which 344.690 were imported and 313.571 were exported. The percentage of imported empty TEU with respect to the total number of TEU imported from Gdansk (26%) is similar to the exported empty ones (33%). In other words, a 33% of TEU exported from Gdansk in 2012 were empty, while a 26% of the imported ones were empty.

With mainland China the total movement of both loaded and empty TEU from Gdansk in 2012 was 256.372 TEU units, from which 163.247 were imported and 93.125 were exported. However, the real maritime transport of goods in containers from Gdansk with mainland China is given by Table 106, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Gdansk with mainland China in 2012 was 177.161 TEU units, from which 163.247 were imported and 13.914 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Gdansk with mainland China is 0% for imports and 85% for exports. These values contrast with the previous ones of Gdansk with the rest of the World. They show that all the containers imported from Gdansk coming from mainland China are loaded, while almost a 90% of the exported ones from Gdansk to mainland China are empty, proving the predominant unidirectional way of the trade between these two countries.

Unfortunately, information about the imports in transit TEU from Port of Gdansk when the commercial partner is mainland China was not available. From all the sources of information checked, the data found was empty or not reliable. Moreover, Port Authority of Gdansk did not provide such information due to confidential reasons, adducing that such information is sensitive. On the other side, the rate of usage of inland waterways from Port of Gdansk was significant: 8.162 out of 163.247 loaded TEU were imported coming from mainland China and distributed to the hinterland through inland waterways, which represents a 5% of the total.

It can be supposed that the transhipment rate of Gdansk will be low, as its position in the Baltic Sea suggests that it has a huge hinterland to serve. In that sense, from Port of Gdansk they are promoting the Port as a gateway to the Baltic Sea market, instead of using Hamburg and Rotterdam as hub ports that offer feeders to Gdansk in order to supply goods to the hinterland. Port of Gdansk states that mother ships directly arriving from the Far-East to Gdansk – instead of going first to Hamburg or Rotterdam and after by a feeder service to Gdansk – saves feeder costs and transhipment costs, imply a lower inland transport cost, lower CO_2 emissions and shorter transit time.

In the last four years the evolution of Port of Gdansk is extremely positive, and from data collected for 2013 it seems that the amount of TEU handled in the Port is even higher than in the previous years. This means that probably part of the objectives of the Port concerning the capitation of traffics coming from mainland China are being satisfied.

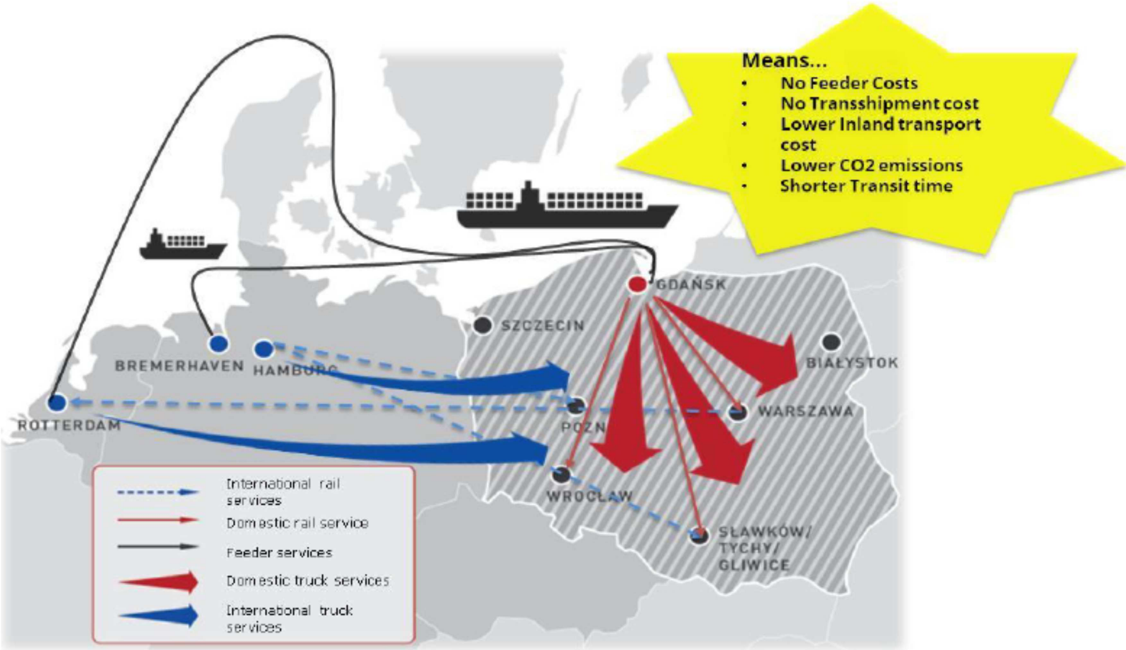


Figure 60. Port of Gdansk as a gateway Port to the Baltic Sea area (*source: Port Authority of Gdansk*)

In Gdansk also exists inland waterway transport. However, as seen in Figure 61, not a large amount of TEU is distributed to the hinterland through inland waterways. If we assume that the percentage of TEU distributed to the hinterland is 5%, and that it can be extrapolated to the case of imports from Gdansk coming from China, then 8.162 out of 163.247 both loaded and empty TEU (8.162 out of 163.247 loaded TEU) were imported in 2012 and distributed to the hinterland through inland waterways.

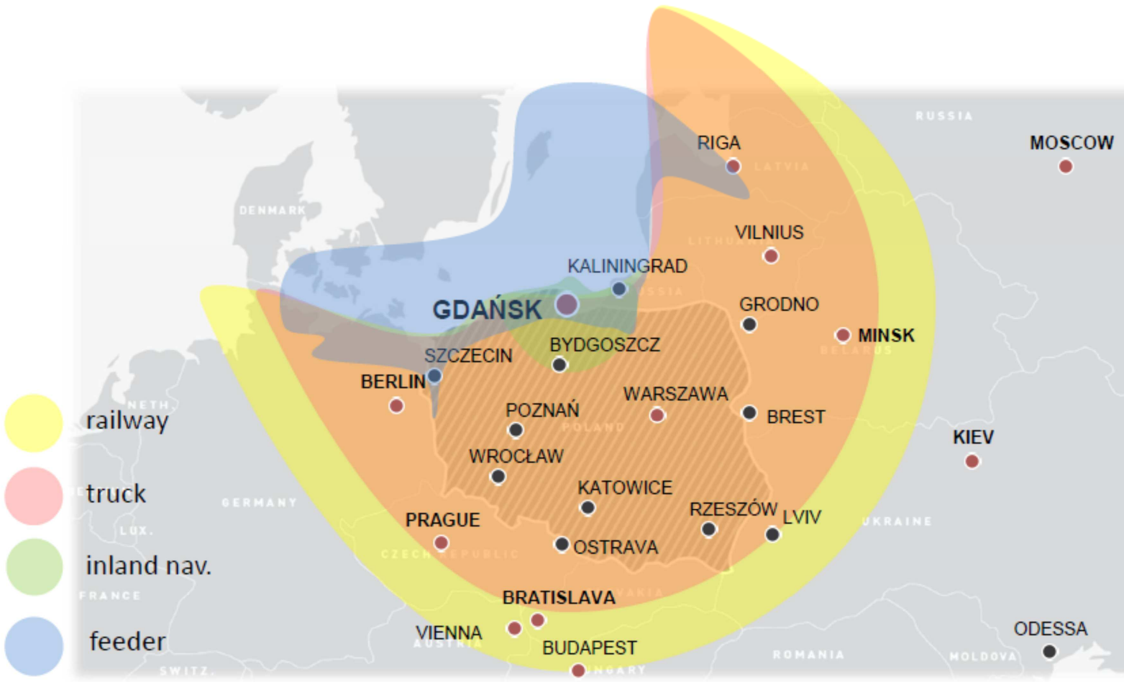


Figure 61. Modal split of the hinterland distribution at Port of Gdansk (*source: Port Authority of Gdansk*)

2.1.17. La Spezia

The Port of La Spezia lies at the head of the Gulf of La Spezia on Italy's northwestern Ligurian coast. It's Italy's main naval station and arsenal, and it houses a navigation school. Commercial seaport activities include importing coal, oil, and natural gas.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from La Spezia from the year 2000 until the second semester of 2013 is shown in Figure 62, together with the influence of mainland China as its trade partner. Between 2000 and 2008 the amount of both loaded and empty TEU transported from La Spezia increased gradually from 150 thousand TEU quarterly to 325 thousand TEU quarterly, decreasing drastically in 2009 to 140 thousand TEU quarterly due to the European economic recession, and recovering in 2009 again. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from La Spezia has increased significantly since 2000.

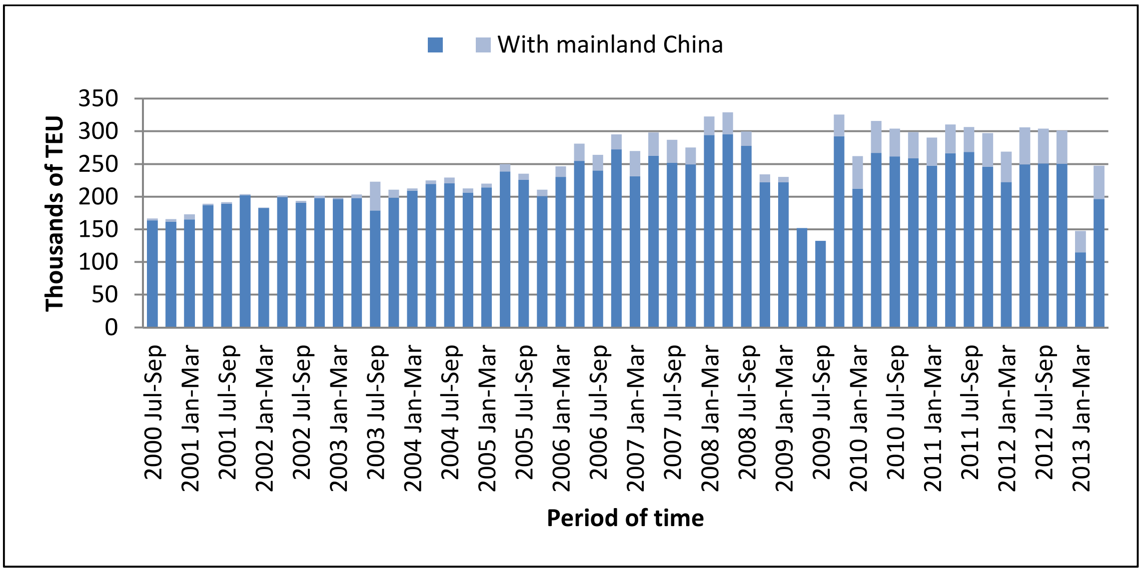


Figure 62. Total maritime transport of both loaded and empty TEU from La Spezia (*source: own-source using Eurostat data*)

The total number of TEU transported from La Spezia and from La Spezia with mainland China is reported here. As for this specific study, also the imports in transit from La Spezia have been recorded. The rate of empty TEU transported to and from La Spezia has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 108. Number of both loaded and empty TEU transported from La Spezia (*source: own-source using Port Authority of La Spezia data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	543.036	575.405	630.576	578.401	596.456	613.566	**607.813**
Total import	543.451	554.666	555.346	261.966	584.149	591.436	**572.938**

Import in transit (15% total import)	81.518	83.200	83.302	39.295	87.622	88.715	**85.941**

Table 109. Number of loaded TEU transported from La Spezia (*source: own-source using Port Authority of La Spezia data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	515.694	535.997	587.471	529.418	568.157	584.630	**594.176**
Total import	367.240	417.720	418.145	189.896	442.234	417.349	**353.768**
Import in transit (15% total import)	55.086	62.658	62.722	28.484	66.335	62.602	**53.065**

Table 110. Percentage of empty TEU with respect to the total number of TEU transported from La Spezia (*source: own-source using Port Authority of La Spezia data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	5	7	7	8	5	5	**2**
Total import	32	25	25	28	24	29	**38**

Table 111. Number of both loaded and empty TEU transported from La Spezia with mainland China (*source: own-source using Port Authority of La Spezia data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	8.514	15.656	-	1.692	13.491	28.219	**53.770**
Total import	80.553	119.480	-	39.761	167.339	148.413	**153.958**
Import in transit	12.083	17.922	-	5.964	25.101	22.262	**23.094**

Table 112. Number of loaded TEU transported from La Spezia with mainland China (*source: own-source using Port Authority of La Spezia data*)

	2006	2007	2008	2009	2010	2011	2012	**2013**
Total export	8.143	15.298	-	1.692	12.755	27.432	53.654	**-**
Total import	68.454	111.461	-	38.804	164.813	127.875	132.105	**119.180**

Import in transit	10.268	16.719	-	5.821	24.722	19.181	19.816	**6.300**

Table 113. Percentage of empty TEU with respect to the total number of TEU transported from La Spezia with mainland China (*source: own-source using Port Authority of La Spezia data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	4	2	-	0	5	3	**0**
Total import	15	7	-	2	2	14	**14**

The total movement of both loaded and empty TEU from La Spezia in 2012 was 1.180.751 TEU units, from which 572.938 were imported and 607.813 were exported. However, the real maritime transport of goods in containers from La Spezia is given by Table 109, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from La Spezia in 2012 was 947.944 TEU units, from which 353.768 were imported and 594.176 were exported. The percentage of empty TEU with respect to the total number of TEU transported from La Spezia is much higher in the imports (38%) than in the exports (2%). In other words, a 38% of TEU imported from La Spezia in 2012 were empty, while almost none of the exported ones were empty. These values show that La Spezia is currently a bigger exporter than importer, and this tendency has increased in the past few years.

With mainland China the total movement of both loaded and empty TEU from La Spezia was 207.728 TEU units, from which 153.958 were imported and 53.770 were exported. However, the real maritime transport of goods in containers from La Spezia with mainland China is given by Table 112, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from La Spezia with mainland China in 2012 was 185.759 TEU units, from which 132.105 were imported and 53.654 were exported. Data was received concerning the imported loaded TEU coming from mainland China in 2013: 119.180 TEU. The percentage of empty TEU with respect to the total number of TEU transported from La Spezia with mainland China in 2012 is 0% for exports and 14% for imports. In other words, almost all the TEU exported from La Spezia to mainland China in 2012 were loaded, while a 14% of the imported ones coming from China were empty.

Moreover, Table 111 and Table 112 include information about the imports in transit from Port of La Spezia coming from mainland China. It can be seen that in 2013, 6.300 out of 119.180 loaded TEU were imported in transit from this port when the commercial partner is mainland China, which represents a 5,3% of the total. The remaining 112.880 out of 119.180 TEU that were not transhipped in 2013, were directed to the hinterland. Out of them, 90.112 (79,8%)

were delivered by truck to the hinterland, while 22.768 (20,2%) were delivered by rail to the hinterland.

2.1.18. Sines

The Port of Sines is an open deep-water seaport in Sines, Portugal. It is the main port of the country's Ibero-atlantic front, and began operating in 1978. The Port of Sines and its industrial and logistics zone are sited on more than 2.000 ha. Within the scope of Portugal Logístico (the country's logistic system), the port is integrated within the national urban platform of Poceirao, as well as on the Elvas/Caia trans-boundary logistic platforms.

P3 The Alliance, which will bring together Maersk, MSC and CMA CGM container ship owners have chosen to operate in Sines Portugal transshipment services and hub containers at the container terminal of the Port of Sines and connecting rail freight between the port Sines – Madrid – Paris – Europe.

The Port of Sines direct hinterland comprises all the south and midland part of Portugal. It is located at 150 km from Lisbon, 125 km from Evora, 100 km from Beja and 182 km from Faro. Users of the port can interact with all the authorities and port services through a single communication channel.

The Sines Container Terminal, called Terminal XXI, started its operations in 2004 under a public service concession by the company PSA Sines (PSA – Port Singapore Authority). Terminal XXI provides beds of 16 meters ZH, allowing the mooring of large container ships from intercontinental routes and of the ships with the respective connections by feeder. The open sea port is sheltered by two breakwaters – West Breakwater (2.000 m N-S orientation) and the East Breakwater (2.200 m NW-SE orientation).

The Port of Sines and the Industrial and Logistics Zone offer road and rail connections directly linked to the terminals. Links to both the Portuguese and Spanish hinterland (IC33 – Sines/Evora/Spain; IP8 – Sines/Beja/Spain; and rail connection Sines/Elvas/Spain) are planned.

The land allocated to the development of the ZAL at Sines covers two areas: one situated in the intra-port zone and the other one in the extra-port zone.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Sines from the year 2000 until the second semester of 2013 is shown in Figure 63, together with the influence of mainland China as its trade partner. There is no data available between 2000 and 2004, but from 2004 the presence of Sines in the European map of ports has increased exponentially from transporting almost no TEU in 2004 to more than 200 thousand TEU quarterly in 2013, and the tendency is to keep rising. This situation is very similar to the one in

Gdansk. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Sines has increased significantly since 2004.

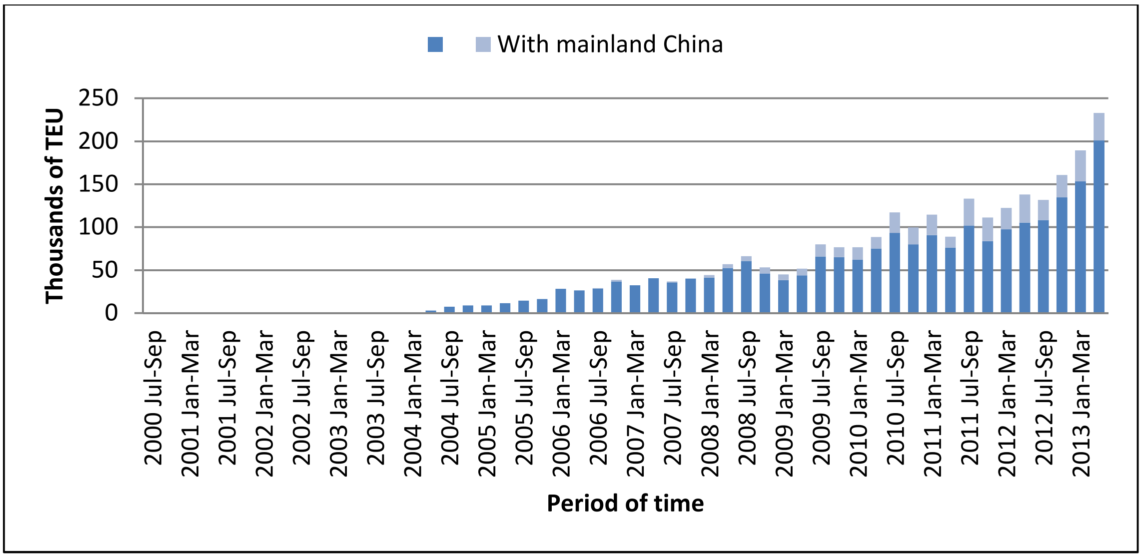


Figure 63. Total maritime transport of both loaded and empty TEU from Sines (*source: own-source using Eurostat data*)

The total number of TEU transported from Sines and from Sines with mainland China is reported here. Although the imports in transit from Sines were tried to be reported, the Port Authority of Sines did not provide us this information, regarding their confidential policies concerning sensitive data. The rate of empty TEU transported to and from Sines has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 114. Number of both loaded and empty TEU transported from Sines (*source: own-source using Port Authority of Sines data*)

	2010	2011	**2012**
Total export	190.621	226.666	**275.105**
Total import	191.461	220.831	**277.960**

Table 115. Number of loaded TEU transported from Sines (*source: own-source using Port Authority of Sines data*)

	2010	2011	**2012**
Total export	168.899	202.732	**266.877**
Total import	157.102	181.575	**214.259**

Table 116. Percentage of empty TEU with respect to the total number of TEU transported from Sines (*source: own-source using Port Authority of Sines data*)

	2010	2011	**2012**
Total export	11	11	**3**

Total import	18	18	**23**

Table 117. Number of both loaded and empty TEU transported from Sines with mainland China (*source: own-source using Port Authority of Sines data*)

	2010	2011	**2012**
Total export	21.438	28.193	**18.402**
Total import	49.875	66.530	**88.937**

Table 118. Number of loaded TEU transported from Sines with mainland China (*source: own-source using Port Authority of Sines data*)

	2010	2011	**2012**
Total export	11.569	17.974	**18.225**
Total import	49.835	66.474	**88.467**

Table 119. Percentage of empty TEU with respect to the total number of TEU transported from Sines with mainland China (*source: own-source using Port Authority of Sines data*)

	2010	2011	**2012**
Total export	46	36	**1**
Total import	0	0	**1**

The total movement of both loaded and empty TEU from Sines in 2012 was 553.065 TEU units, from which 277.960 were imported and 275.105 were exported. However, the real maritime transport of goods in containers from Sines is given by Table 115, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Sines in 2012 was 481.136 TEU units, from which 214.259 were imported and 266.877 were exported. The percentage of imported empty TEU with respect to the total number of TEU imported from Sines (23%) is much higher than the exported empty ones (3%). In other words, only a 3% of TEU exported from Sines in 2012 were empty, while a 23% of the imported ones were empty. This shows that Sines currently plays more the exporter role than the importer one. This can be explained by the low demand currently existing in Southern Europe due to the Economic recession, that has changed the previous scenario where all Europe was importing much more rather than exporting.

With mainland China the total movement of both loaded and empty TEU from Sines in 2012 was 107.339 TEU units, from which 88.937 were imported and 18.402 were exported. However, the real maritime transport of goods in containers from Sines with mainland China is given by Table 118, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Sines with mainland China in 2012 was 106.692 TEU units, from which 88.467 were imported and 18.225 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Sines with mainland China is 1% both for imports and exports. These values contrast with the previous ones of Sines with the rest of the World. They show that almost all the containers both imported and exported from Sines with mainland China are loaded, proving the intensity of the commerce between these two countries.

Unfortunately, information about the imports in transit TEU from Port of Sines when the commercial partner is mainland China was not available. From all the sources of information checked, the data found was empty or not reliable. Moreover, Port Authority of Sines did not provide such information due to confidential reasons, adducing that such information is sensitive.

2.1.19. Genova

The Port of Genova is a major Italian seaport on the Mediterranean Sea. With a trade volume of 51,6 million tonnes, it is the busiest port of Italy by cargo tonnage and the second busiest in terms of TEU after the transhipment port of Gioia Tauro, with a trade volume of 2,1 million TEU handled in 2012.

The Port of Genova covers an area of about 700 ha of land and 500 ha on water, stretching for over 22 km along the coastline, with 47 km of maritime ways and 30 km of operative quays. There are four main entrances: the Eastern inlet – affording access to the old port, to shipyards, and to the terminals of Sampierdarena –, the Western inlet – used mostly by ships operating at the ILVA quays –, the Multedo entrance – for ships operating in the oil terminals and to the Fincantieri shipyards – and the Pra entrance – at the western end of the port, for ships operating at the container terminal –.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Genova from the year 2000 until the second semester of 2013 is shown in Figure 64, together with the influence of mainland China as its trade partner. From 2000 to 2004 the maritime transport of both loaded and empty TEU from Genova was stable at around 400 thousand TEU quarterly, decreasing slightly in 2005 and 2006, but increasing in 2007 and 2008. From 2008, when the European economic recession started, the tendency in the transport of TEU from the port has been unpredictable, although in 2012 and 2013 it became stable at around 425 thousand TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Genova has increased significantly since 2000.

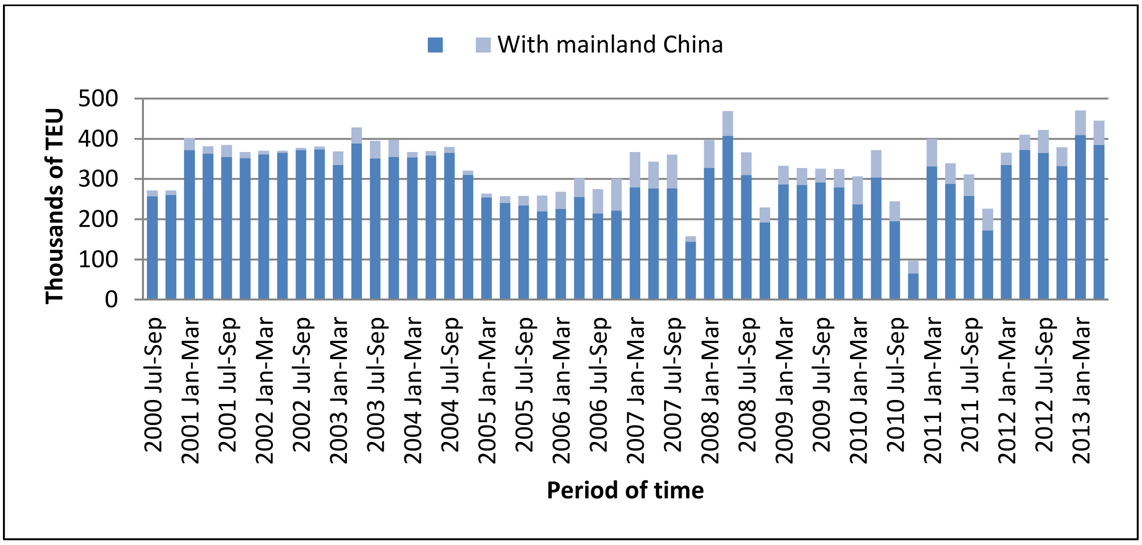


Figure 64. Total maritime transport of both loaded and empty TEU from Genova (*source: own-source using Eurostat data*)

The total number of TEU transported from Genova and from Genova with mainland China is reported here. As for this specific study, also the imports in transit from Genova have been recorded. The rate of empty TEU transported to and from Genova has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 120. Number of both loaded and empty TEU transported from Genova (*source: own-source using Port Authority of Genova data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	568.647	580.567	677.183	638.978	524.253	647.319	**898.810**
Total import	577.096	649.019	784.726	672.229	495.796	629.606	**678.758**
Import in transit (13% total import)	75.022	84.372	102.014	87.390	64.453	81.849	**88.239**

Table 121. Number of loaded TEU transported from Genova (*source: own-source using Port Authority of Genova data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	544.766	570.077	663.622	620.715	515.805	622.279	**747.665**
Total import	574.047	644.863	773.968	653.868	489.918	621.067	**676.003**
Import in transit (13% total import)	74.626	83.832	100.616	85.003	63.689	80.739	**87.880**

Table 122. Percentage of empty TEU with respect to the total number of TEU transported from Genova (*source: own-source using Port Authority of Genova data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	4	2	2	3	2	4	**17**
Total import	1	1	1	3	1	1	**0**

Table 123. Number of both loaded and empty TEU transported from Genova with mainland China (*source: own-source using Port Authority of Genova data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	115.401	113.476	92.898	75.039	91.227	100.425	**85.214**
Total import	112.514	138.683	131.794	92.665	126.633	126.386	**87.778**
Import in transit (13% total import)	14.627	18.029	17.133	12.046	16.462	16.430	**11.411**

Table 124. Number of loaded TEU transported from Genova with mainland China (*source: own-source using Port Authority of Genova data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	109.378	109.944	88.077	66.667	85.138	100.079	**85.150**
Total import	112.388	138.075	131.787	91.145	126.633	123.188	**87.778**
Import in transit (13% total import)	14.610	17.950	17.132	11.849	16.462	16.014	**11.411**

Table 125. Percentage of empty TEU with respect to the total number of TEU transported from Genova with mainland China (*source: own-source using Port Authority of Genova data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	5	3	5	11	7	0	**0**
Total import	0	0	0	2	0	3	**0**

The total movement of both loaded and empty TEU from Genova in 2012 was 1.577.568 TEU units, from which 678.758 were imported and 898.810 were exported. However, the real maritime transport of goods in containers from Genova is given by Table 121, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Genova in 2012 was 1.423.668 TEU units, from which 676.003 were imported and 747.665 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Genova is much higher in the exports (17%) than in the imports (0%). In other words, a 17% of TEU exported from Genova in 2012 were empty, while almost none of the imported ones were empty. From these values it must be noted that the percentage of empty exported TEU in 2012 (17%) increased significantly within the previous year values, which were around 2-4%.

With mainland China the total movement of both loaded and empty TEU from Genova was 172.992 TEU units, from which 87.778 were imported and 85.214 were exported. However, the real maritime transport of goods in containers from Genova with mainland China is given by Table 124, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Genova with mainland China in 2012 was 172.928 TEU units, from which 87.778 were imported and 85.150 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Genova with mainland China is 0% both for imports and exports. In other words, absolutely all the TEU imported from Genova coming from mainland China in 2012 were loaded, while only 64 out of 85.214 TEU were exported empty from Genova to mainland China.

Moreover, Table 123 and Table 124 include information about the imports in transit from Port of Genova coming from mainland China. It can be seen that in 2012, 11.411 out of 87.778 both loaded and empty TEU (11.411 out of 87.778 loaded TEU) were imported in transit from this port, which represents a 13% of the total. This percentage agrees with a research carried out by ITMMA, "Economic Analysis of the European Seaport System" (2009), where the rate of transhipment from Genova is fixed at 13%; and also agrees with Port of Genova available information.

2.1.20. Gioia Tauro

The Port of Gioia Tauro in southern Italy is one of the largest seaports in Italy and the seventh largest container port in Europe in 2010. It is situated along the route connecting Suez to Gibraltar, one of the busiest maritime corridors in the world.

The port has seven loading docks with an extension of 4.646 m: in 2007 it had a throughput of 3,7 million TEU from more than 3.000 ships.

The seaport represents more than a third of the whole national traffic and is specialized in transhipment activities, taking the place of the Malta seaport as the node for overseas traffic from/to USA and from/to the Far East. The Medcenter Container Terminal (Medcenter, Contship) is the main operator working within the seaport of Gioia Tauro.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Gioia Tauro from the year 2000 until the second semester of 2013 is shown in Figure 65, together with the influence of mainland China as its trade partner. From 2000 to 2008 the total maritime transport of both loaded and empty TEU ranged between 0,6 and 0,9 million TEU quarterly. In 2008, due to the European economic recession, it decreased to less than 0,6 million TEU quarterly, increasing after until reaching 1 million TEU quarterly in 2010, same value as in 2013, although it decreased in 2011 to 0,7 million TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Gioia Tauro is not very significant, and has decreased in the last two years.

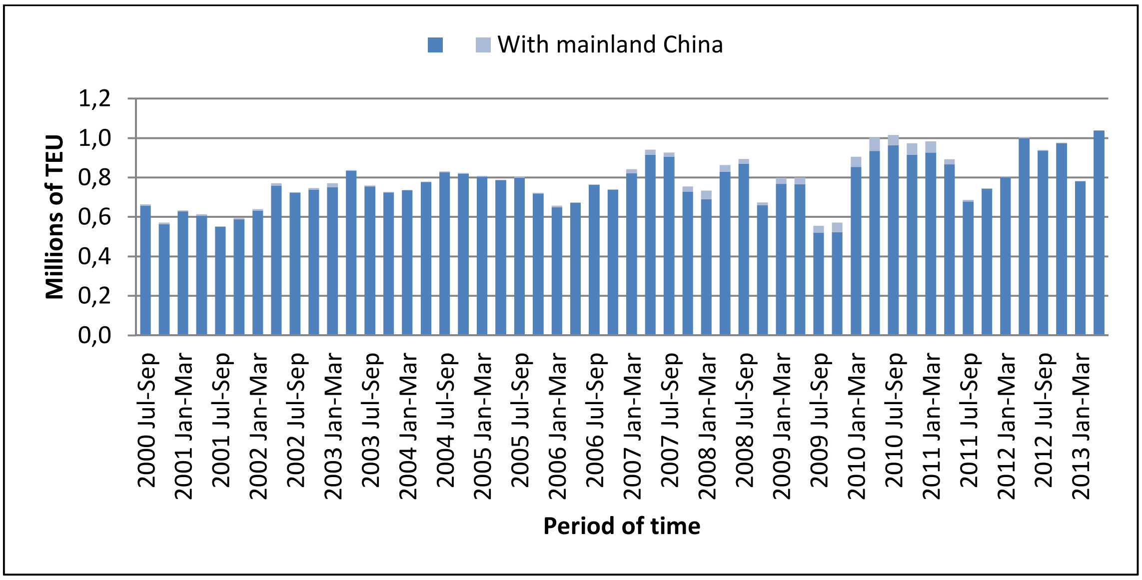


Figure 65. Total maritime transport of both loaded and empty TEU from Gioia Tauro (*source: own-source using Eurostat data*)

Again, the total number of TEU transported from Gioia Tauro and from Gioia Tauro with mainland China is reported here. As for this specific study, also the imports in transit from Gioia Tauro coming from mainland China have been recorded. The rate of empty TEU transported to and from Gioia Tauro has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 126. Number of both loaded and empty TEU transported from Gioia Tauro (*source: own-source using Port Authority of Gioia Tauro data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	1.401.449	1.765.824	1.577.819	1.379.497	1.882.046	1.551.028	**1.884.132**
Total import	1.433.787	1.698.355	1.586.975	1.345.209	2.014.620	1.755.976	**1.841.063**
Import in transit (95% total import)	1.362.098	1.613.437	1.507.626	1.277.949	1.913.889	1.668.177	**1.749.010**

Table 127. Number of loaded TEU transported from Gioia Tauro (*source: own-source using Port Authority of Gioia Tauro data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	1.153.147	1.465.339	1.434.052	1.275.004	1.627.252	1.370.457	**1.629.733**
Total import	1.109.565	1.392.724	1.421.341	1.226.764	1.803.952	1.569.324	**1.596.293**
Import in transit (95% total import)	1.054.087	1.323.088	1.350.274	1.165.426	1.713.754	1.490.858	**1.516.478**

Table 128. Percentage of empty TEU with respect to the total number of TEU transported from Gioia Tauro (*source: own-source using Port Authority of Gioia Tauro data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	18	17	9	8	14	12	**14**
Total import	23	18	10	9	10	11	**13**

Table 129. Number of both loaded and empty TEU transported from Gioia Tauro with mainland China (*source: own-source using Port Authority of Gioia Tauro data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	8.412	18.256	32.811	58.474	95.682	35.022	**4.817**
Total import	5.067	75.165	83.807	89.116	133.460	57.152	**11.093**
Import in transit (95% total import)	4.814	71.407	79.617	84.660	126.787	54.294	**10.538**

Table 130. Number of loaded TEU transported from Gioia Tauro with mainland China (*source: own-source using Port Authority of Gioia Tauro data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	596	13.750	28.956	45.340	57.070	27.572	**3.259**

Total import	5.019	74.587	83.803	88.512	131.602	56.946	**11.043**
Import in transit (95% total import)	4.768	70.858	79.613	84.086	125.022	54.099	**10.491**

Table 131. Percentage of empty TEU with respect to the total number of TEU transported from Gioia Tauro with mainland China (*source: own-source using Port Authority of Gioia Tauro data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	93	25	12	22	40	21	**32**
Total import	1	1	0	1	1	0	**0**

The total movement of both loaded and empty TEU from Gioia Tauro in 2012 was 3.725.195 TEU units, from which 1.841.063 were imported and 1.884.132 were exported. However, the real maritime transport of goods in containers from Gioia Tauro is given by Table 127, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Gioia Tauro in 2012 was 3.226.026 TEU units, from which 1.596.293 were imported and 1.629.733 were exported. The percentage of imported empty TEU with respect to the total number of TEU transported from Gioia Tauro (13%) is similar to that of the exported empty ones (14%). In other words, a 14% of TEU exported from Gioia Tauro in 2012 were empty, while a 13% of the imported ones were empty. These percentages have been kept more or less constant during the last five years, slightly decreasing if comparing to ten years ago.

With mainland China the total movement of both loaded and empty TEU from Gioia Tauro in 2012 was 15.910 TEU units, from which 11.093 were imported and 4.817 were exported. However, the real maritime transport of goods in containers from Gioia Tauro with mainland China is given by Table 130, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Gioia Tauro with mainland China in 2012 was 14.302 TEU units, from which 11.043 were imported and 3.259 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Gioia Tauro with mainland China is 0% for imports and 32% for exports. These values contrast with the previous ones of Gioia Tauro with the rest of the World. They show that almost all the containers imported from Gioia Tauro coming from mainland China are loaded, while around a 30% of the exported ones from Gioia Tauro to mainland China are empty.

Moreover, Table 129 and Table 130 include information about the imports in transit from Port of Gioia Tauro coming from mainland China. It can be seen that in 2012, 10.538 out of 11.093 both loaded and empty TEU (10.491 out of 11.043 loaded TEU) were imported in transit from this port, which represents a 95% of the total. This percentage of imports in transit shows the big role of transhipment port that plays Gioia Tauro, as almost all the imports from the port are after transhipped to another final destination.

From all the sources of information checked, the data concerning the final destination of the imports in transit from Gioia Tauro coming from China was not available. However, from Eurostat the export information from Gioia Tauro in terms of TEU could be downloaded. Therefore, the principal commercial partners of the port were noticed. Although the exports from Gioia Tauro have nothing to do with the imports in transit from the same port, estimation can be done about where approximately the cargo unloaded in Gioia Tauro and loaded into another ship goes to.

Table 132. Destination of TEU exported from Gioia Tauro in 2012 (*source: own-source using Eurostat data*)

Destination	TEU exported in 2012 from Gioia Tauro	%
Belgium	5.727	0,4
Denmark	11	0,0
Germany (until 1990 former territory of the FRG)	822	0,1
Estonia	27	0,0
Ireland	28	0,0
Greece	74.967	4,6
Spain	61.854	3,8
France	52.703	3,2
Croatia	28.777	1,8
Italy	229.142	14,1
Cyprus	2.589	0,2
Latvia	10	0,0
Lithuania	16	0,0
Malta	1.193	0,1
Netherlands	908	0,1
Poland	37	0,0
Portugal	237	0,0
Slovenia	19.636	1,2
Finland	11	0,0
Sweden	31	0,0

United Kingdom	6.306	0,4
Norway	11	0,0
Montenegro	37.476	2,3
Serbia	13.599	0,8
Turkey	91.437	5,6
United Arab Emirates	153.454	9,4
Albania	12.329	0,8
Argentina	592	0,0
Australia	16.242	1,0
Brazil	2.653	0,2
Canada	1.824	0,1
Cocos (Keeling) Islands (AU)	738	0,0
Chile	28	0,0
China (except Hong Kong)	3.259	0,2
Algeria	131	0,0
Egypt	139.672	8,6
Ghana	1	0,0
Gibraltar (UK)	700	0,0
Israel	38.295	2,3
India	21.194	1,3
Lebanon	3.858	0,2
Sri Lanka	28.875	1,8
Libya	95.937	5,9
Morocco	774	0,0
Mauritius	5.640	0,3
Mexico	3.945	0,2
Oman	35.321	2,2
Panama	4.867	0,3
Philippines	2	0,0
Russia	223	0,0
Saudi Arabia	330.454	20,3
Singapore	41.510	2,5
Senegal	308	0,0
Syria	12	0,0
Tunisia	48.311	3,0
Ukraine	1.908	0,1
United States	9.112	0,6
Asian countries	499.521	30,7
Total	**1.629.724**	**100,0**

The Asian countries of the list have been marked in red colour in order to separate them from the rest. It is obvious that a container that comes from mainland China will not be imported in transit from Gioia Tauro and redirected to mainland China again. To simplify the analysis, the main destinations have been summarised in the following Table 133, once excluded the Asian countries and reformulated the percentages. From this table it can be seen that the biggest part of the exports from Gioia Tauro go to Italy (23,5%), Egypt (14,3%), Libya (9,8%), Turkey (9,4%) and Greece (7,7%). America only represents a 4,8%.

Table 133. Export of TEU from Gioia Tauro in 2012 (*source: own-source*)

Destination	%
Greece	7,7
Spain	6,3
France	5,4
Croatia	2,9
Italy	23,5
Slovenia	2,0
Montenegro	3,8
Turkey	9,4
Egypt	14,3
Libya	9,8
Tunisia	4,9
Rest of Europe	4,5
Rest of Africa	0,7
America	4,8

Once observed the influence areas of the exports from Gioia Tauro, and considering that we are only interested in the final destination of the imports in transit coming from mainland China, a common sense distribution is done for them. These percentages are taken only as a reference to estimate the importance of each region in the traffic with mainland China.

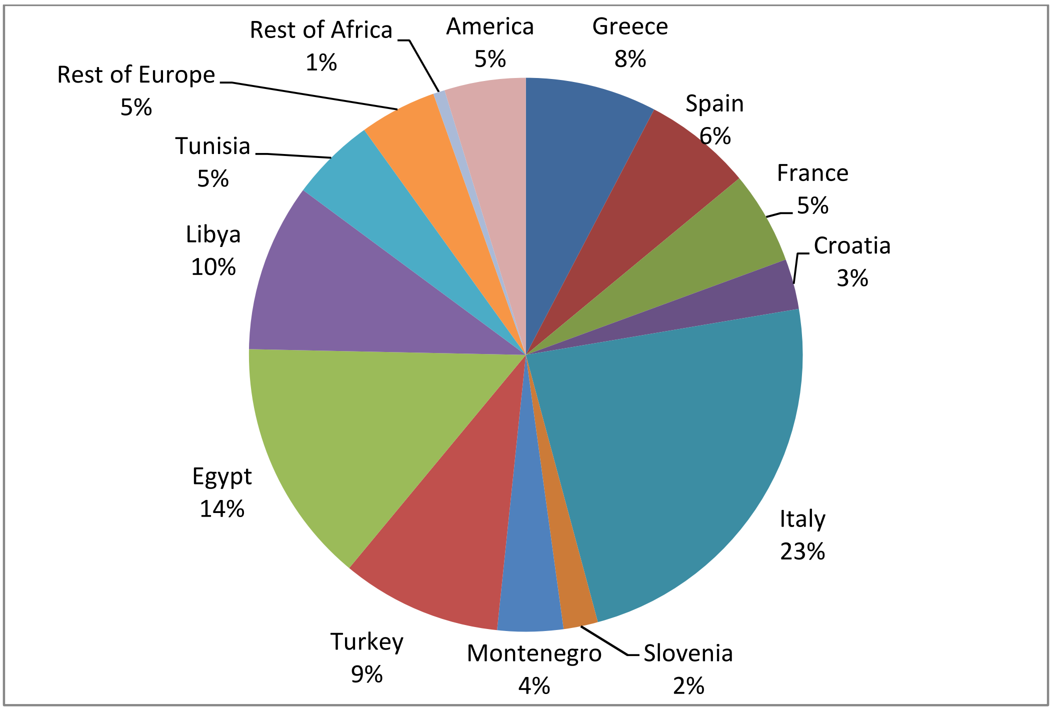


Figure 66. Main final destinations of TEU imported from Gioia Tauro coming from mainland China and transhipped (*source: own-source*)

2.1.21. Cagliari

The Port of Cagliari is one of the largest Italian seaports and one of the largest seaports in the Mediterranean Sea basin, with an annual traffic capacity of around 50 million tonnes of cargo and one million TEU. The port is also an important employer in the area, with more than 3.000 employees who provide services to more than 5.500 ships every year.

The Port of Cagliari is in the west of the Mediterranean Sea, a position which has made it a commercial and strategic junction for over 2.500 years. Founded by the Phoenicians, launched by the Carthaginians and flourished under the Romans, for centuries the port in Cagliari has been in a continuous expansion program.

The Port is situated 18 km from the Gibraltar-Suez ideal line and represents one of the poles for transhipping activities in the Western Mediterranean Sea. The territorial district managed by the Cagliari Port Authority extends for approximately 30 km of coastline; its structure is divided into two areas: the historic port and the canal port. The historic port has 5.800 m of quay, which serves commercial and Ro-Ro traffic as well as passenger ships. The canal port has 1.600 m of quay and has five berths for transhipping and Ro-Ro traffic. These two ports are flanked by berths for the petrochemical and oil industry, which accommodate mooring for 17 ships at a time.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Cagliari from the year 2000 until the second semester of 2013 is shown in Figure 67, together with the influence of mainland China as its trade partner. Although the data of this port is not very reliable, it shows how Cagliari has appeared as an important port in the Mediterranean Sea in the last decade, and that also suffered the European economic crisis in 2008. In the last three years the amount of both loaded and empty TEU transported from the port has remained constant at about 140 thousand TEU quarterly. In addition, it can be clearly seen that the influence of mainland China in the total maritime transport of TEU from Cagliari is completely zero in the last three years, while from 2005 to 2009 was very low.

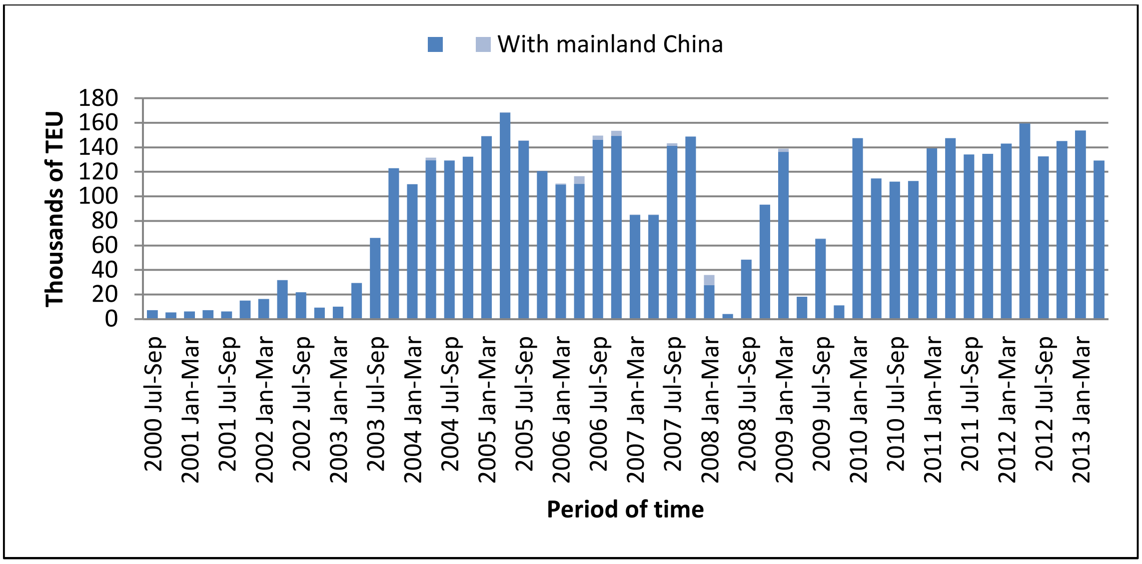


Figure 67. Total maritime transport of both loaded and empty TEU from Cagliari (*source: own-source using Eurostat data*)

The total number of TEU transported from Cagliari and from Cagliari with mainland China is reported here. The rate of empty TEU transported to and from Cagliari has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 134. Number of both loaded and empty TEU transported from Cagliari (*source: own-source using Port Authority of Cagliari data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	264.839	192.961	82.089	124.639	244.563	305.559	313.091
Total import	265.139	268.874	99.497	109.067	242.053	307.630	314.518

Table 135. Number of loaded TEU transported from Cagliari (*source: own-source using Port Authority of Cagliari data*)

	2006	2007	2008	2009	2010	2011	**2012**

Total export	262.723	182.169	74.521	117.764	244.559	257.818	259.250
Total import	258.201	258.646	86.820	108.807	242.049	270.883	267.660

Table 136. Percentage of empty TEU with respect to the total number of TEU transported from Cagliari (*source: own-source using Port Authority of Cagliari data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	1	6	9	6	0	16	**17**
Total import	3	4	13	0	0	12	**15**

Table 137. Number of both loaded and empty TEU transported from Cagliari with mainland China (*source: own-source using Port Authority of Cagliari data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	2.094	2.219	2.564	2.709	0	0	0
Total import	12.755	41	5.970	0	0	0	0

Table 138. Number of loaded TEU transported from Cagliari with mainland China (*source: own-source using Port Authority of Cagliari data*)

	2006	2007	2008	2009	2010	2011	**2012**
Total export	2.094	15	0	145	0	0	0
Total import	12.755	41	5.970	0	0	0	0

The total movement of both loaded and empty TEU from Cagliari in 2012 was 627.609 TEU units, from which 314.518 were imported and 313.091 were exported. However, the real maritime transport of goods in containers from Cagliari is given by Table 135, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Cagliari in 2012 was 526.910 TEU units, from which 267.660 were imported and 259.250 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Cagliari (17%) is similar to that in the imports (15%). In other words, a 17% of TEU exported from Genova in 2012 were empty, while a 15% of the imported ones were empty.

Despite being one of the largest sea ports in the Mediterranean basin, the Port of Cagliari does not import or export any TEU with mainland China. This is shown both in Eurostat data and in the Port Authority data from Port of Cagliari, where it is seen that there are no shipping lines between mainland China and Cagliari. As there is no commercial relation between Cagliari and mainland China, the transits from Cagliari are not considered.

2.1.22. Malta

The Port of Malta considered here includes both Malta Freeport or Marsaxlokk and La Valletta Port.

Malta Freeport is an international port on the island of Malta with a trade volume of 2,56 million TEU in 2012. It is one of the busiest ports in the Mediterranean Europe. It lies in Birzebbuga in the south-eastern part of Malta, on the site of the former seaplane base RAF Kalafrana. Having been established in 1988, Malta Freeport was the first transhipment hub in the Mediterranean region. The company has experienced remarkable growth over the years and currently ranks twelfth among the top European ports and is the third largest transhipment and logistics centre in the Mediterranean region. Over 95% of the Freeport's container traffic is transhipment business with demand growth triggering successive rounds of funding and ownership changes.

As the Mediterranean's third largest transhipment port, Malta Freeport represents a strategic platform for the shipping lines that have chosen it as their Mediterranean hub port being located at the crossroads of some of the world's greatest shipping routes and in the heart of Europe, Africa and Asian's Middle East triangle. Malta Freeport terminals will be increasing its quay length on both terminals from the present operational length of 2,2 km to over 3 km and the total area from 680.000 m^2 to 790.000 m^2.

Valletta is the capital of Malta, and its port is also important in the maritime transport from the country. La Valletta Port is located in the central-eastern portion of the island of Malta. In the traffic of containers, Marsaxlokk is a bigger port than Valletta, but in this study we add together both ports.

The quarterly evolution of the total maritime transport of both loaded and empty TEU from Malta from the year 2000 until the second semester of 2013 is shown in Figure 68, together with the influence of mainland China as its trade partner. There is no data available for the period 2000-2002. From 2003 to 2013 the amount of both loaded and empty TEU transported from Malta has been kept more or less constant at around 25 thousand TEU quarterly. However, in the period 2006-2007 it decreased slightly until reaching around 15 thousand TEU quarterly. In addition, the influence of mainland China in the total maritime transport of TEU from Malta has increased slightly since 2003, but not as much as in the other European ports analysed.

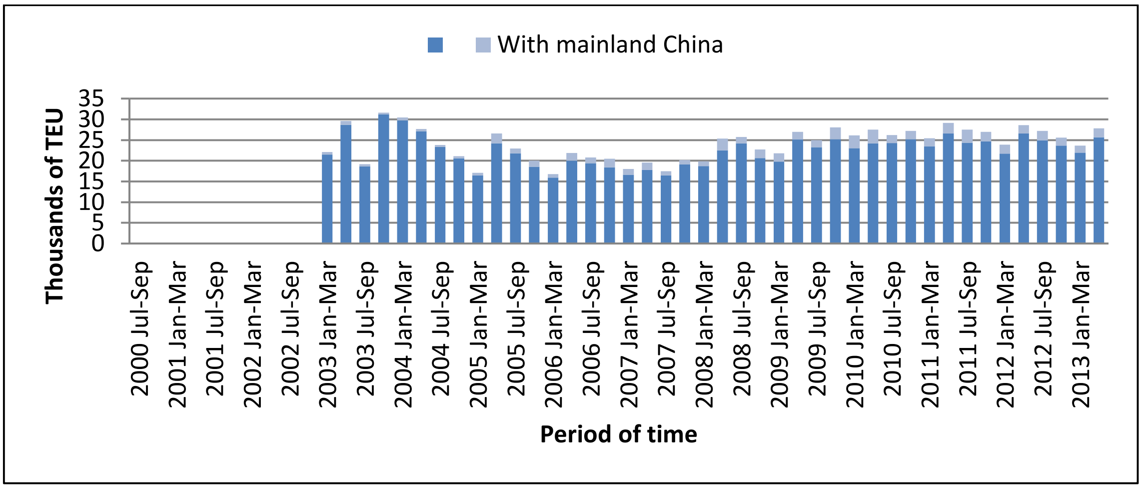


Figure 68. Total maritime transport of both loaded and empty TEU from Malta (*source: own-source using Eurostat data*)

The total number of TEU transported from Malta and from Malta with mainland China is reported here. As for this specific study, also the imports in transit from Malta have been recorded. The rate of empty TEU transported to and from Malta has been taken into account, as a way of measuring the real movement of goods from the Port.

Table 139. Number of both loaded and empty TEU transported from Malta (Marsaxlokk + Valletta) (*source: own-source using Port Authority of Malta data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	25.094	17.556	11.403	33.167	36.964	41.793	43.852	40.201
Total import	61.600	62.375	63.868	60.503	64.819	65.306	65.238	65.150

Table 140. Number of loaded TEU transported from Malta (Marsaxlokk + Valletta) (*source: own-source using Port Authority of Malta data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	10.519	12.102	8.170	7.788	8.691	10.323	11.745	11.281
Total import	60.590	62.257	63.861	60.164	63.365	62.193	63.414	61.977

Table 141. Percentage of empty TEU with respect to the total number of TEU transported from Malta (Marsaxlokk + Valletta) (*source: own-source using Port Authority of Malta data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total	58	31	28	77	76	75	73	**72**

export								
Total import	2	0	0	1	2	5	3	**5**

Table 142. Number of both loaded and empty TEU transported from Malta (Marsaxlokk + Valletta) with mainland China (*source: own-source using Port Authority of Malta data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	651	46	70	3.416	3.416	5.870	4.905	1.985
Total import	5.088	6.133	5.278	4.175	5.018	4.596	5.122	6.528
Import in transit (96% total import)	4.884	5.888	5.067	4.008	4.817	4.412	4.917	6.267

Table 143. Number of loaded TEU transported from Malta (Marsaxlokk + Valletta) with mainland China (*source: own-source using Port Authority of Malta data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	19	38	70	141	271	307	470	418
Total import	5.086	6.133	5.277	4.175	5.018	4.596	5.121	6.528
Import in transit (96% total import)	4.883	5.888	5.066	4.008	4.817	4.412	4.916	6.267

Table 144. Percentage of empty TEU with respect to the total number of TEU transported from Malta (Marsaxlokk + Valletta) with mainland China (*source: own-source using Port Authority of Malta data*)

	2005	2006	2007	2008	2009	2010	2011	**2012**
Total export	97	17	0	96	92	95	90	79
Total import	0	0	0	0	0	0	0	0

The total movement of both loaded and empty TEU from Malta in 2012 was 105.351 TEU units, from which 65.150 were imported and 40.201 were exported. However, the real maritime transport of goods in containers from Malta is given by Table 140, where the empty TEU transported from the Port are excluded. Therefore, the total movement of loaded TEU from Malta in 2012 was 73.258 TEU units, from which 61.977 were imported and 11.281 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Malta is much higher in the exports (72%) than in the imports (5%). In other words, a 72% of TEU exported from Malta in 2012 were empty, while only a 5% of the imported ones were empty. These percentages have been kept more or less constant during the last five years, and they show that Malta is not a big exporter of goods in containers.

With mainland China the total movement of both loaded and empty TEU from Malta in 2012 was 8.513 TEU units, from which 6.528 were imported and 1.985 were exported. However, the real maritime transport of goods in containers from Malta with mainland China is given by Table 143, where the empty TEU transported from the Port with mainland China are excluded. Therefore, the total movement of loaded TEU from Malta with mainland China in 2012 was 6.946 TEU units, from which 6.528 were imported and 418 were exported. The percentage of empty TEU with respect to the total number of TEU transported from Malta with mainland China is 0% for imports and 79% for exports. These values are even extremer than the previous ones of Malta with the rest of the world. They show that all the containers imported from Malta coming from mainland China are loaded, while around an 80% of the exported ones from Malta to mainland China are empty.

Moreover, Table 142 and Table 143 include information about the imports in transit from Port of Malta coming from mainland China. It can be seen that in 2012, 6.267 out of 6.528 both loaded and empty TEU (all of them loaded TEU) were imported in transit from this port, which represents a 96% of the total. This percentage of imports in transit shows the big role of transhipment port that plays Malta, as almost all the imports from the port are after transhipped to another final destination.

From all the sources of information checked, the data concerning the final destination of the imports in transit coming from China was not available. However, from Eurostat the export information from Malta in terms of TEU could be downloaded. Therefore, the principal commercial partners of the port were noticed. Although the exports from Malta have nothing to do with the imports in transit from the same port, estimation can be done about where approximately the cargo unloaded in Malta and loaded into another ship goes to.

Table 145. Destination of TEU exported from Malta in 2012 (*source: own-source using Eurostat data*)

Destination	TEU exported in 2012 from Malta	%	% excluding Asia
Belgium	528	1,3	1,6
Bulgaria	148	0,4	0,4
Denmark	3	0,0	0,0
Germany	304	0,8	0,9
Estonia	3	0,0	0,0
Ireland	231	0,6	0,7
Greece	2.687	6,7	8,0
Spain	4.055	10,1	12,1
France	668	1,7	2,0
Croatia	480	1,2	1,4

Italy	11.110	27,6	33,2
Cyprus	115	0,3	0,3
Latvia	2	0,0	0,0
Lithuania	1	0,0	0,0
Netherlands	427	1,1	1,3
Poland	8	0,0	0,0
Portugal	88	0,2	0,3
Romania	4	0,0	0,0
Slovenia	48	0,1	0,1
Sweden	9	0,0	0,0
United Kingdom	996	2,5	3,0
Iceland	2	0,0	0,0
Norway	73	0,2	0,2
Switzerland	0	0,0	0,0
Montenegro	124	0,3	0,4
Turkey	2.921	7,3	8,7
United Arab Emirates	1.694	4,2	-
Antigua and Barbuda	1	0,0	0,0
Albania	15	0,0	0,0
Angola	206	0,5	0,6
Argentina	1	0,0	0,0
Australia	102	0,3	0,3
Bangladesh	36	0,1	-
Bahrain	38	0,1	-
Benin	7	0,0	0,0
Brazil	49	0,1	0,1
Belize	2	0,0	0,0
Canada	47	0,1	0,1
Democratic Republic of the Congo	13	0,0	0,0
Congo	10	0,0	0,0
Côte d'Ivoire	18	0,0	0,1
Cameroon	100	0,2	0,3
China (except Hong Kong)	1.985	4,9	-
Cape Verde	5	0,0	0,0
Djibouti	87	0,2	0,3
Dominica	41	0,1	0,1
Algeria	104	0,3	0,3
Ecuador	2	0,0	0,0

Egypt	3.943	9,8	11,8
Eritrea	1	0,0	0,0
Fiji	13	0,0	0,0
Gabon	8	0,0	0,0
Ghana	24	0,1	0,1
Gambia, The	9	0,0	0,0
Guinea	24	0,1	0,1
Guatemala	4	0,0	0,0
Guinea-Bissau	11	0,0	0,0
Hong Kong	147	0,4	-
Haiti	1	0,0	-
Indonesia	81	0,2	-
Israel	21	0,1	-
India	506	1,3	-
Iran	1	0,0	-
Jamaica	2	0,0	0,0
Jordan	83	0,2	-
Japan	289	0,7	-
Kenya	47	0,1	0,1
South Korea	37	0,1	-
Kuwait	64	0,2	-
Cayman Islands (UK)	5	0,0	0,0
Lebanon	484	1,2	-
Sri Lanka	3	0,0	-
Liberia	22	0,1	0,1
Libya	1.444	3,6	4,3
Morocco	340	0,8	1,0
Mauritius	11	0,0	0,0
Mexico	16	0,0	0,0
Malaysia	334	0,8	-
Mozambique	3	0,0	0,0
Namibia	2	0,0	0,0
Nigeria	207	0,5	0,6
New Zealand	22	0,1	0,1
Oman	144	0,4	0,4
Peru	19	0,0	0,1
Papua New Guinea	3	0,0	0,0
Philippines	7	0,0	-
Pakistan	46	0,1	-

Qatar	60	0,1	-
Russia	4	0,0	0,0
Saudi Arabia	300	0,7	-
Seychelles	8	0,0	0,0
Sudan	30	0,1	0,1
Singapore	55	0,1	-
Sierra Leone	33	0,1	0,1
Senegal	142	0,4	0,4
Suriname	6	0,0	0,0
Togo	21	0,1	0,1
Thailand	321	0,8	-
Tunisia	390	1,0	1,2
Trinidad and Tobago	20	0,0	0,1
Taiwan	93	0,2	-
Tanzania	2	0,0	0,0
Ukraine	10	0,0	0,0
United States	360	0,9	1,1
Saint Vincent and the Grenadines	1	0,0	0,0
Venezuela	10	0,0	0,0
Vietnam	41	0,1	-
Yemen	253	0,6	0,8
South Africa	17	0,0	0,1
Total	**40.203**	**100,0**	-
Total except Asia	**33.476**	**-**	**100,0**

The Asian countries of the list have been marked in red colour in order to separate them from the rest. It is obvious that a container that comes from mainland China will not be imported in transit from Malta and redirected to mainland China again. To simplify the analysis, the main destinations have been summarised in the following Table 146, once excluded the Asian countries and reformulated the percentages. From this table can be seen that the biggest part of the exports from Malta go to Italy (33,2%), Spain (12,1%), Egypt (11,8%), Turkey (8,7%) and Greece (8,0%).

Table 146. Export of TEU from Malta in 2012 (*source: own-source*)

Destination	**%**
Belgium	1,6
Greece	8,0
Spain	12,1

Italy	33,2
Netherlands	1,3
United Kingdom	3,0
Turkey	8,7
Egypt	11,8
Libya	4,3
Morocco	1,0
Tunisia	1,2
United States	1,1
Others	12,8

Once observed the influence areas of the exports from Malta, and considering that we are only interested in the final destination of the imports in transit coming from China, a common sense distribution will be done for them. These percentages will be taken only as a reference to estimate the importance of each region in the traffic with China.

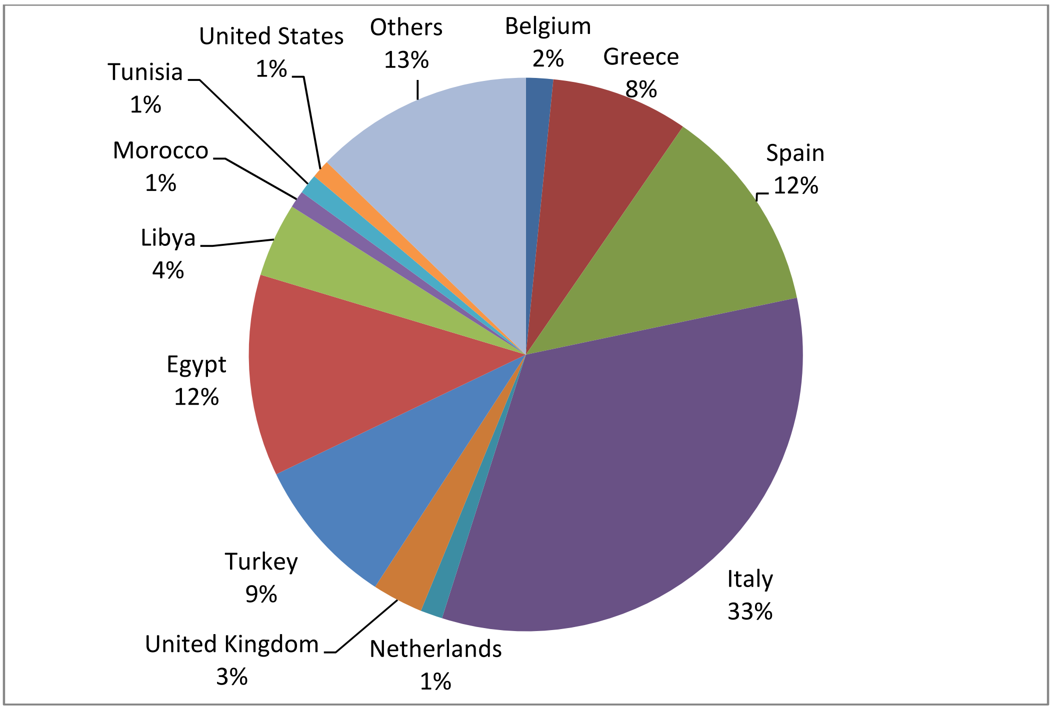


Figure 69. Main final destinations of TEU imported from Malta coming from mainland China and transhipped (*source: own-source*)

2.1.23. Tanger MED

Tanger MED is a cargo port located about 40 km east of Tangier, Morocco. It is one of the largest ports on the Mediterranean and in Africa by capacity and went into service in July 2007. Its initial capacity was 3,5 million shipment containers.

The Tangier-Med Project will contain the biggest port in Africa. The project is a strategic priority of the Moroccan government for the economic and social development of the North Morocco region. It is part of the economic policy orienting Morocco towards exports, based on eight clearly identified export sectors, with particular emphasis on the free trade agreement with the European Union.

The Tanger-Med project has important economic effects in terms of jobs, creation of added value and foreign investment. Its particular position on the Straits of Gibraltar, at the crossing of two major maritime routes, and 15 km from the European Union enables it to serve a market of hundreds of millions of consumers through the industrial and commercial free zones which are run by well-known private operators. It also wins part of the strong growth market of container transhipment and becomes the leading hub for cereal transhipment, a facility which is non-existent in the north-west African region at present.

Since 2012 new port facilities were built in Tanger Med in order to meet the growing demand for containers treatment at the international level in sea transport. These facilities include two new container terminals with a total length of 2.800 m and an additional nominal capacity of 5 million containers. The port is expected to reach full capacity by 2015, and to operate 8 million containers, 7 million passengers, 700.000 trucks, 2 million vehicles and 10 million MT of oil products.

For not being in the European Union, information about the imports and exports of containerized goods from Tanger MED was difficult to get. However, after contacting the Port Authority of Tanger MED, it was stated that in 2013, 190.000 TEU units were imported from Tanger MED coming from mainland China.

2.2. The current container flow from mainland China to Europe

With all the data collected until now for each of the selected ports, some summary tables have been built in order to get some knowledge about the current transport of TEU from and to Europe.

The 23 ports selected for the analysis and displayed in the following tables are chosen based on their importance in the transport of TEU from mainland China to Europe. Except Bilbao, Gioia Tauro, Cagliari and Malta, the rest of the European Ports analysed are the 18th biggest importers of TEU coming from mainland China. Bilbao (ranking 22nd), Gioia Tauro (ranking 33rd), Malta (ranking 45th) and Cagliari were also analysed because of their importance in the transport of TEU in the Mediterranean Sea (case of Gioia Tauro, Malta and Cagliari) or because of their Spanish condition (case of Bilbao).

When considering the total import of both loaded and empty TEU (Table 147), in 2012 Rotterdam leaded the ranking with a total amount of 6.002.317 TEU imported, followed by Hamburg (4.606.647 TEU) and Antwerp (4.005.958 TEU). These three ports are ahead from their pursuers, leaded by Bremerhaven in the 4th place (2.947.692 TEU). Concerning the Spanish ports, Valencia was the biggest importer of both loaded and empty TEU in 2012, ranking 5th in Europe, with 2.226.545 TEU, Algeciras second in Spain and 6th in Europe (2.067.872 TEU) and Barcelona was the third one and 12nd in Europe (869.223 TEU).

However, when analysing the transport of TEU, it is crucial to determine what the percentage of them that are empty, in order to get information about the real trade of goods in the ports. In that sense, the % of empty TEU imported from each of the selected ports was also determined. There exist big differences between the 23 ports selected.

Some ports import a very little amount of empty TEU. For example, Genova (0%), Felixstowe (2%), Southampton (5%), Malta (5%) and Marseille (8%). On the other hand, some ports import a large amount of empty TEU. For example, Bilbao (52%), Barcelona (40%), La Spezia (38%) and Valencia (27%). The main reasons why these percentages vary enormously from one port to another are the presence of a wider hinterland to feed, the hub role of the ports and the reciprocity of their commercial relations with other ports.

Table 147. Total import of both loaded and empty TEU and % of empty imported TEU from the selected European ports, 2012 (*source: own-source using Eurostat data*)

Rank	Port	Total import (both loaded and empty TEU), 2012	% empty imported TEU, 2012
1	Rotterdam	6.002.317	19
2	Hamburg	4.606.647	16
3	Antwerp	4.005.958	21
4	Bremerhaven	2.947.692	16
5	Valencia	2.226.545	27
6	Algeciras	2.067.872	21
7	Gioia Tauro	1.841.063	13
8	Felixstowe	1.702.375	2
9	Ambarli	1.527.312	18
10	Piraeus	1.417.669	15
11	Le Havre	1.028.668	15
12	Barcelona*	869.223	40
13	Southampton	748.803	5
14	Genova	678.758	0
15	Marseille	614.151	8
16	La Spezia	572.938	38

17	Zeebrugge	475.693	12
18	Gdansk	464.331	26
19	Cagliari	314.518	15
20	Bilbao*	296.361	52
21	Sines	277.960	23
22	Malta	65.150	5

* Data from 2013

As it is said before, there exist a big difference between the import of both loaded and empty TEU and the import of only the loaded TEU. The second ones are a measure of the real importation of goods from the selected ports. Therefore, Table 148 displays the total import of loaded TEU from the selected European ports in 2012. In other words, it consists of applying the % of empty imported TEU to the amount of both loaded and empty TEU imported from the ports.

It can be seen that Rotterdam still leads the ranking with 4.834.196 loaded TEU imported, followed by Hamburg (3.857.178 TEU) and Antwerp (3.158.925 TEU). Some ports have experienced a change in rank. This is the case, for example, of Felixstowe, which before ranked 8th and now ranks 5th thanks to its low percentage of empty TEU imported (2%). On the opposite case, Valencia, with a relatively high % of empty imported TEU, ranks now 7th in Europe, in comparison with its previous top 5. Another port that moves downwards three positions in the ranking is Barcelona, now at rank 15th due to its 40% of empty imported TEU.

Table 148. Total import of loaded TEU from the selected European ports, 2012 (*source: own-source using Eurostat data*)

Rank	**Port**	**Change in rank with respect to Table 147**	**Total import (loaded TEU), 2012**
1	Rotterdam	=	4.834.196
2	Hamburg	=	3.857.178
3	Antwerp	=	3.158.925
4	Bremerhaven	=	2.484.115
5	Felixstowe	+3	1.665.723
6	Algeciras	=	1.631.754
7	Valencia	-2	1.619.698
8	Gioia Tauro	-1	1.596.293
9	Ambarli	=	1.256.006
10	Piraeus	=	1.199.529
11	Le Havre	=	873.010

12	Southampton	+1	710.406
13	Genova	+1	676.003
14	Marseille	+1	562.895
15	Barcelona*	-3	523.765
16	Zeebrugge	+1	416.851
17	La Spezia	-1	353.768
18	Gdansk	=	344.690
19	Cagliari	=	267.660
20	Sines	+1	214.259
21	Bilbao*	-1	141.359
22	Malta	=	61.977

* Data from 2013

The same analysis can be done for exports instead of imports. In this case, in 2012 Rotterdam also leaded the ranking of both loaded and empty TEU exported with a total amount of 4.936.187 TEU, followed by Hamburg (4.284.066 TEU) and Antwerp (4.168.417 TEU). These three ports are again approximately 1 million TEU far away from their pursuers, leaded by Bremerhaven in the 4th place (3.163.508 TEU). Concerning the Spanish ports, Valencia was in 2012 the biggest exporter of both loaded and empty TEU in 2012, ranking 5th in Europe, with 2.243.962 TEU, followed by Algeciras, ranking 6th in Europe (2.030.894 TEU) and Barcelona, ranking 13rd in Europe (849.182 TEU).

But again, when analysing the transport of TEU, it is crucial to determine what the percentage of them that are empty, in order to get information about the real trade of goods in the ports. In that sense, the % of empty TEU exported from each of the selected ports was also determined. There exist big differences between the 23 ports selected, even higher than in the case of the imports.

Some ports export a very little amount of empty TEU. For example, La Spezia (2%), Sines (3%), Antwerp (5%), Bilbao (5%), Bremerhaven (7%) and Barcelona (9%). On the other hand, some ports export a large amount of empty TEU. For example, Malta (72%), Souhtampton (54%), Felixstowe (49%) and Gdansk (33%). The main reasons why these percentages vary enormously from one port to another are the presence of a big production centre close to the ports, the hub role of the ports and the reciprocity of their commercial relations with other ports.

There are some interesting cases among them. For example, the case of the English ports: Felixstowe (2% of empty TEU in the imports and 49% in the exports) and Southampton (5% of empty TEU in the imports and 54% in the exports). In these cases the results are logical, as England has a huge hinterland to feed but does not play a big role as a producer of goods.

Other examples of the same situation are Malta (5% and 72%, respectively) and Genova (0% and 17%, respectively).

The opposite situation happens in other ports such as La Spezia. Before it was stated that La Spezia imports a large amount of empty TEU (38%). However, only exports a 2% of empty TEU. This shows that La Spezia plays a big role as an exporter and not that much as an importer. Same happens in Barcelona, where the percentage of empty TEU is much higher in the imports (40%) than in the exports (9%). Other examples of this situation are observed in Valencia (27% in the imports and 20% in the exports), Bremerhaven (16% and 7%, respectively), Antwerpen (21% and 5%, respectively), Sines (23% and 3%, respectively), and Bilbao (52% and 5%, respectively). In all these cases, the ports play an exporter role rather than an importer one. A possible explanation of this situation is the economic crisis that is affecting Europe since 2008. Some ports that before were importing more than exporting are changing their role, for example Barcelona.

Table 149. Total export of both loaded and empty TEU and % of empty exported TEU from the selected European ports, 2012 (*source: own-source using Eurostat data*)

Rank	Port	Total export (total loaded and empty TEU), 2012	% empty exported TEU, 2012
1	Rotterdam	4.936.187	20
2	Hamburg	4.284.066	11
3	Antwerp	4.168.417	5
4	Bremerhaven	3.163.508	7
5	Valencia	2.243.962	20
6	Algeciras	2.030.894	18
7	Gioia Tauro	1.884.132	14
8	Felixstowe	1.665.293	49
9	Ambarli	1.496.650	26
10	Piraeus	1.397.395	23
11	Le Havre	1.086.123	17
12	Genova	898.810	17
13	Barcelona*	849.182	9
14	Southampton	740.465	54
15	La Spezia	607.813	2
16	Marseille	541.183	10
17	Gdansk	469.095	33
18	Zeebrugge	454.426	20
19	Bilbao*	313.635	5

20	Cagliari	313.091	17
21	Sines	275.105	3
22	Malta	40.201	72

* Data from 2013

Table 150 displays the total export of loaded TEU from the selected European ports in 2012. In other words, it consists of applying the % of empty exported TEU to the amount of both loaded and empty TEU exported from the ports. It can be seen how Rotterdam still leads the ranking with 3.969.686 total loaded TEU exported, but now followed by Antwerp (3.967.301 TEU) and Hamburg (3.818.940 TEU), that have switched their positions. Some other ports have also experienced a change in rank. This is the case, for example, of Felixstowe, which before ranked 8th and now ranks 11th due to its high percentage of empty TEU exported (49%). Same case for Southampton, which falls from the 14th position to the 17th due to its 54% of exported empty TEU. On the opposite case, there are some ports that thanks to its low percentage of exported empty TEU, rank in a better position now, such as Sines (3%, +1 position), La Spezia (2%, +1 position), Barcelona (9%, +1 position) and Antwerp (5%, +1 position).

Table 150. Total export of loaded TEU from the selected European ports, 2012 (*source: own-source using Eurostat data*)

Rank	Port	Change in rank with respect to Table 149	Total export (total loaded TEU), 2012
1	Rotterdam	=	3.969.686
2	Antwerp	+1	3.967.301
3	Hamburg	-1	3.818.940
4	Bremerhaven	=	2.936.769
5	Valencia	=	1.794.918
6	Algeciras	=	1.659.269
7	Gioia Tauro	=	1.629.733
8	Ambarli	+1	1.104.702
9	Piraeus	+1	1.078.602
10	Le Havre	+1	905.475
11	Felixstowe	-3	846.252
12	Barcelona*	+1	770.903
13	Genova	-1	747.665
14	La Spezia	+1	594.176
15	Marseille	+1	488.504
16	Zeebrugge	+2	364.832

17	Southampton	-3	338.512
18	Gdansk	-1	313.571
19	Bilbao*	=	297.711
20	Sines	+1	266.877
21	Cagliari	-1	259.250
22	Malta	=	11.281

* Data from 2013

Until now, general information about the imports and exports from the European selected ports has been given. But the objective of this study is to analyse the maritime transport of TEU from the European ports when their commercial partner is mainland China. As a summary, Table 151 ranks the European selected ports concerning the transport of both loaded and empty TEU from mainland China to them. It can be seen that the ranking now changes with respect to that of Table 147. This means that not for being a big importer of TEU it must also be the same big importer of TEU when the commercial partner is mainland China. That is why Table 151 also includes the change in rank with respect to the previous Table 147.

If in 2012 Rotterdam was the major importer of TEU in Europe, concerning only the transport of TEU from mainland China to Europe Hamburg is the number one, importing 1.471.351 both loaded and empty TEU annually coming from mainland China, followed by Rotterdam (1.430.011 TEU) and Felixstowe (680.804 TEU), that has raised five positions with respect to the previous ranking. Concerning the Spanish ports, Valencia is the biggest importer of both loaded and empty TEU coming from mainland China, and remains top 5 in Europe, with 420.379 TEU, followed by Barcelona, ranking 13rd in Europe (186.309 TEU) and Algeciras, ranking 15th in Europe and falling 9 positions (159.126 TEU). Other ports that have experienced a drop down are Antwerp (falling 7 positions and ranking now 10th, with 233.073 both loaded and empty TEU imported coming from mainland China), Genova (falling 4 positions and ranking now 18th, with 87.778 TEU), and Gioia Tauro (falling 13 positions and ranking now 20th, with 11.093 TEU). On the other side, some ports have gained importance in the transport of both loaded and empty TEU from mainland China to Europe, such as the already mentioned Felixstowe, Le Havre (moving from top 11 to top 5, with 360.154 both loaded and empty TEU imported coming from mainland China), Southampton (moving from top 13 to top 6, with 357.745 TEU), Marseille (moving from top 15 to top 11, with 205.670 TEU), Zeebrugge (moving from top 17 to top 12, with 193.759 TEU), Gdansk (moving from top 18 to top 14, with 163.247 TEU) and Sines (moving from top 21 to top 17, with 88.937 TEU).

As it was stated before, when analysing the transport of TEU, it is crucial to determine what the percentage of them that are empty, in order to get information about the real trade of goods in the ports. In that sense, the % of empty TEU imported from each of the selected ports and coming from mainland China was also determined. It can be seen now that, when the commercial partner is mainland China, the rate of empty imported TEU from the European ports is almost zero for all the cases except for two: Antwerp (14%) and La Spezia (14%).

Table 151. Both loaded and empty TEU and % of empty TEU transported from mainland China to the selected European ports, 2012 (*source: own-source using Eurostat data*)

Rank	Port	Change in rank with respect to Table 147	From mainland China to the Port (both loaded and empty TEU), 2012	% empty TEU, 2012
1	Hamburg	+1	1.471.351	1
2	Rotterdam	-1	1.430.011	1
3	Felixstowe	+5	680.804	0
4	Bremerhaven	=	473.912	1
5	Valencia	=	420.379	0
6	Le Havre	+5	360.154	1
7	Southampton	+6	357.745	2
8	Ambarli	+1	250.390	2
9	Piraeus	+1	235.390	1
10	Antwerp	-7	233.073	14
11	Marseille	+4	205.670	1
12	Zeebrugge	+5	193.759	2
13	Barcelona*	-1	186.309	1
14	Gdansk	+4	163.247	0
15	Algeciras	-9	159.126	0
16	La Spezia	=	153.958	14
17	Sines	+4	88.937	1
18	Genova	-4	87.778	0
19	Bilbao*	+1	26.634	0
20	Gioia Tauro	-13	11.093	0
21	Malta	+1	6.528	0
22	Cagliari	-3	0	0

* Data from 2013

On the other side, also the both loaded and empty TEU exported from each of the selected European ports to mainland China was recorded in 2012. The new ranking is leaded by Hamburg, with 791.188 both loaded and empty TEU exported to mainland China in 2012, followed by Felixstowe (538.994 TEU) and Bremerhaven (323.649 TEU). In the case of Felixstowe, it is noticeable that 538.994 TEU out of the total 1.665.293 both loaded and empty TEU exported from the port, are directed to mainland China. Concerning the Spanish Ports, Valencia is the biggest exporter to mainland China and top 6 in Europe (with 216.317 both loaded and empty TEU in 2012), followed by Algeciras, top 12 in Europe (with 91.189 TEU) and Barcelona, top 14 in Europe (with 84.903 TEU).

Now the % of empty exported TEU from each of the selected ports to mainland China is much more relevant than in the case of the imports coming from this country. In the following table it can be seen how some ports have an extremely high percentage of empty exported TEU to mainland China, while others have it extremely low and almost zero. For example, in Gdansk (85%), Southampton (83%), Malta (79%), Ambarli (66%) and Felixstowe (62%), more than half of the TEU exported to mainland China are empty; whereas in Le Havre (0%), Genova (0%), La Spezia (0%), Bilbao (0%), Sines (1%), Marseille (4%) and Antwerp (12%), almost all the TEU exported to mainland China are loaded. The second group of ports supply goods in containers to mainland China in a bigger percentage than the first group, which mostly returns to mainland China the containers empty.

Table 152. Both loaded and empty TEU and % of empty TEU transported from each of the selected European ports to mainland China, 2012 (*source: own-source using Eurostat data*)

Rank	Port	From the Port to mainland China (both loaded and empty TEU), 2012	% empty TEU, 2012
1	Hamburg	791.188	28
2	Felixstowe	538.994	62
3	Bremerhaven	323.649	24
4	Antwerp	276.336	12
5	Southampton	252.778	83
6	Valencia	216.317	38
7	Ambarli	204.777	66
8	Zeebrugge	173.692	45
9	Piraeus	164.686	28
10	Le Havre	105.496	0
11	Gdansk	93.125	85
12	Algeciras	91.189	44
13	Genova	85.214	0
14	Barcelona*	84.903	45
15	La Spezia	53.770	0
16	Marseille	52.553	4
17	Rotterdam	22.910	43
18	Sines	18.402	1
19	Bilbao*	6.651	0

20	Gioia Tauro	4.817	32
21	Malta	1.985	79
22	Cagliari	0	0

* Data from 2013

Table 153 displays the loaded TEU transported from the selected European ports to mainland China in 2012. In other words, it consists of applying the % of empty exported TEU of the table above to the amount of both loaded and empty TEU exported from the ports to mainland China. Therefore, the new ranking of ports exporting loaded TEU to China is still leaded by Hamburg (570.837 TEU), followed now by Bremerhaven (244.387 TEU) and Antwerp (243.234 TEU), Felixstowe falling from the second position to the fourth with 202.194 TEU. The largest drop down affects Southampton, that falls down from the 5th to the 15th position (42.694 TEU), while Gdansk is also moving from top 11 to top 17 (13.914 TEU). Concerning the Spanish Ports, Valencia is the biggest exporter of loaded TEU to China and 5th in Europe (134.453 loaded TEU), followed by Algeciras at 12th position (50.714 loaded TEU) and Barcelona at 14th position (46.743 loaded TEU).

Table 153. Loaded TEU transported from the selected European ports to mainland China, 2012 (*source: own-source using Eurostat data*)

Rank	**Port**	**Change in rank with respect to Table 152**	**From the Port to mainland China (loaded TEU), 2012**
1	Hamburg	=	570.837
2	Bremerhaven	+1	244.387
3	Antwerp	+1	243.234
4	Felixstowe	-2	202.194
5	Valencia	+1	134.453
6	Piraeus	+3	118.110
7	Le Havre	+3	105.376
8	Zeebrugge	=	95.020
9	Genova	+4	85.150
10	Ambarli	-3	70.027
11	La Spezia	+4	53.654
12	Algeciras	=	50.714
13	Marseille	+3	50.400
14	Barcelona*	=	46.743
15	Southampton	-10	42.694
16	Sines	+2	18.225

17	Gdansk	-6	13.914
18	Rotterdam	-1	13.033
19	Bilbao*	=	6.651
20	Gioia Tauro	=	3.259
21	Malta	=	418
22	Cagliari	=	0

* Data from 2013

This study is not only limited to the import and export of TEU from mainland China to/from Europe, but also pretends to do an exhaustive study about the maritime transits from the European selected ports. Table 154 is a summary of the data collected about the maritime transits and the use of inland waterways from each of the selected ports. The table ranks the ports depending on the number of loaded TEU imported coming from mainland China in 2012, therefore the values are the same as in Table 151 after applying the percentage of empty TEU.

The percentage of maritime transit of the imports coming from mainland China varies from port to port. There are ports with a high rate of transhipment, which play a role as a hub port, while others show a low degree of transhipment. Malta, with a 96% of transhipment, Gioia Tauro (95%) and Algeciras (87,2%) are exclusively hub ports, distributing only a few percentage of the imported TEU through the hinterland. In the case of Malta and Gioia Tauro that is because their position in the Suez-Gibraltar route is very convenient, but also because they do not have a big hinterland to feed. In the case of Algeciras, that is also because the port is in the main Europe-Far East route, and also because it is in an ideal position to feed the African market.

Other ports such as Hamburg (63%) and Bremerhaven (61%), and in a lower degree Valencia (38%), Rotterdam (30%) and Le Havre (29%) also have a relatively high rate of transhipment of the imports coming from mainland China. Moreover, especially in the case of Rotterdam, the inland waterways are important because they allow the port to feed its hinterland through feeder services along them. A 24,5% of TEU imported from mainland China to Rotterdam are distributed to the hinterland through inland waterways. In Hamburg, this percentage is only a 0,7%, and in Le Havre a 6,4%. Antwerp is the port with the strongest use of inland waterways: a 27,2% of the TEU imported from mainland China to the port are distributed to the hinterland through inland waterways.

Finally, ports with a lower rate of transhipment concerning the import of TEU coming from mainland China are Bilbao (0,6%), Marseille (4%), La Spezia (5,3%), Felixstowe (12%), Genova (13%), Barcelona (16,6%), Antwerp (20%) and Zeebrugge (20%). In the case of Barcelona, it decreased its transhipment rate during the last few years, from a 26% in 2008 to this 16,6% in 2013.

Table 154. Maritime transit and influence of inland waterways in the transport of TEU from mainland China to the selected European ports, 2012 (*source: own-source*)

Port	From China to the Port, 2012	Maritime transit, 2012		Hinterland through inland waterways, 2012	
	Loaded TEU	Loaded TEU	%	Loaded TEU	%
Hamburg	1.451.962	914.736	63,0	10.745	0,7
Rotterdam	1.415.554	424.666	30,0	346.811	24,5
Felixstowe	679.414	81.530	12,0	0	0,0
Bremerhaven	468.250	285.633	61,0	7.960	1,7
Valencia	**420.026**	**160.393**	**38,2**	**0**	**0,0**
Le Havre	354.799	102.892	29,0	22.707	6,4
Southampton	351.939	?		?	
Ambarli	244.727	?		0	0,0
Piraeus	233.868	210.481	90,0	0	0,0
Marseille	**204.427**	**8.177**	**4,0**	**11.775**	**5,8**
Antwerp	201.096	40.219	20,0	54.698	27,2
Tanger MED	**190.000**	?		**0**	**0,0**
Zeebrugge	189.972	37.994	20,0	1.900	1,0
Barcelona*	**185.291**	**30.741**	**16,6**	**0**	**0,0**
Gdansk	163.247	?		8.162	5,0
Algeciras	**158.880**	**138.531**	**87,2**	**0**	**0,0**
La Spezia*	**119.180**	**6.300**	**5,3**	**0**	**0,0**
Sines	88.467	?		0	0,0
Genova	**87.778**	**11.411**	**13,0**	**0**	**0,0**
Bilbao*	26.574	163	0,6	0	0,0
Gioia Tauro	**11.043**	**10.491**	**95,0**	**0**	**0,0**
Malta	**6.528**	**6.267**	**96,0**	**0**	**0,0**
Cagliari	**0**	**0**	**0,0**	**0**	**0,0**
TOTAL	**7.253.022**	**2.470.625**	**-**	**464.758**	**-**

* Data from 2013

With the values from Table 154, the following map of transport of TEU from mainland China to Europe has been built, data from 2012 (except Barcelona, Bilbao and La Spezia, whose data is from 2013). It is a visual representation of all the data collected. The arrows' size is proportional in each case to the amount of TEU imported from each Port. As it can be noticed, a total amount of 7.253.022 loaded TEU were transported in 2012 from mainland China to the selected European Ports, from which more than 5 million TEU went to the Northern Europe.

Figure 70. Current map of transport of TEU from mainland China to Europe (*source: own-source*)

Moreover, another map of the maritime transits from the European selected ports of the TEU coming from mainland China has been drawn in Figure 71. The number of TEU transshipped in each port is written next to it, and the arrows show where the final destination of these transshipments is. However, it must be noted that for some ports the information about the final destination of these transshipments was not available. A summary of these transshipments destination from each port is compiled in Table 155.

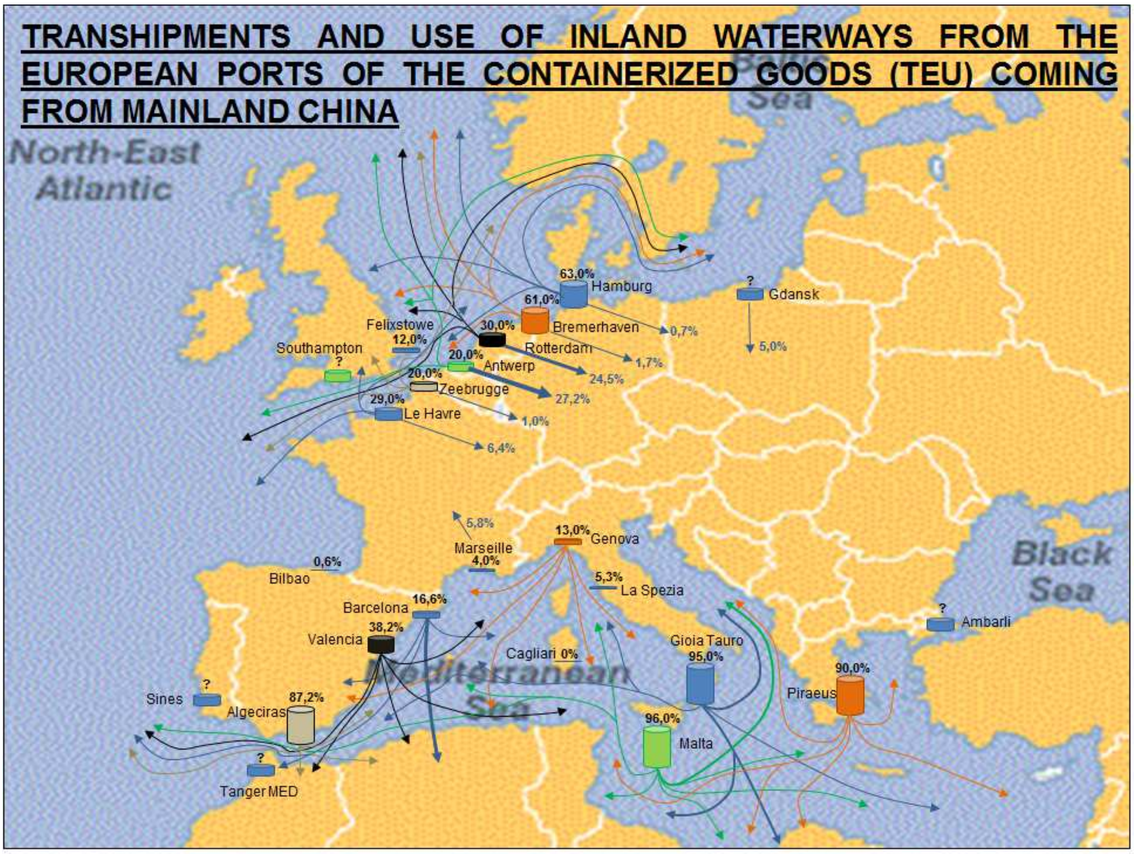


Figure 71. Current map of maritime transits from the European Ports of the TEU coming from mainland China (*source: own-source*)

Table 155. Summary for each port of the main final destinations of the TEU coming from mainland China and transhipped

Port	Main final destinations of the TEU coming from mainland China and transhipped
Tanger MED	No data available
Hamburg	Mainly the Baltic Sea, in a lower degree the UK, Southern Europe and transoceanic routes
Rotterdam	Mainly the Baltic Sea and the UK, in a lower degree Southern Europe and transoceanic routes
Felixstowe	No data available
Bremerhaven	Mainly the Baltic Sea, in a lower degree the UK, Southern Europe and transoceanic routes
Valencia	Arfrica (50%), Europe (30%), America (10%), Others (10%)
Le Havre	No data available
Southampton	No data available
Ambarli	No data available
Piraeus	No data available
Marseille	No data available

Antwerp	Mainly the Baltic Sea and the UK, in a lower degree Southern Europe and transoceanic routes
Zeebrugge	No data available
Barcelona*	Argelia (92,4%), Morocco (4,0%), Spain (2,1%), Others (1,5%)
Gdansk	No data available
Algeciras	Arfrica (60%), Europe (30%), America (7%), Others (3%)
La Spezia	No data available
Sines	No data available
Genova	No data available
Bilbao*	-
Gioia Tauro	Italy (23,5%), Egypt (14,3%), Libya (9,8%), Turkey (9,4%), Greece (7,7%), Spain (6,3%), France (5,4%)
Malta	Italy (33%), Spain(12%), Egypt (12%), Turkey (9%), Greece (8%), Libya (4%), UK (3%)
Cagliari	-

2.3. Main variables for port of destination decision making

Up until now objective data given by recognized Port authorities or official organizations such as Eurostat has been collected in order to define which is the current maritime distribution of containerized goods from mainland China to Europe. In this chapter the maritime factors that influence port choice will be provided. These arguments depend upon the potential for reducing financial costs and externalities within the maritime networks.

Considering the Europe-Far East trades, containers arrive in Europe via Suez. It is evident that the sailing distance from the entrance of the Suez Canal at Port Said is considerably closer to the Barcelona-Rijeka range of ports than to the Le Havre-Hamburg range. Approximately 4.000 km could be saved from an Asia-Europe sea journey if a Southern port is selected instead of a Northern port. There is a need to explain current calling patterns and to consider potential optimisations.

In order to investigate distribution patterns, it is necessary to start from an understanding of liner shipping operations.

Containers arrive in Europe on scheduled container services following rotations (loops) of regular port calls. The competing shipping companies offering capacity on the main trade lanes such as Asia-Europe operate hub and spoke networks, and they attempt to optimise the whole system, and not any single port to port link. An analogy could be made with the difference between main intercontinental airlines (mainly hub and spoke) and low cost carriers (mainly point to point).

It is an unrealistic over-simplification to consider only the journey segment between Suez and the European continent for this analysis, as if to assume that European cargo is all transhipped at Port Said. Transhipment at a Mediterranean hub involves a port call, and therefore additional cost. A large proportion of European container cargo arrives via direct calls as well as via feeder networks, and the proportion differs by region.

A number of examples are illustrated from the current CMA-CGM schedules. They show that four different coastal ranges (North Europe, West Med, Adriatic and Black Sea) are covered separately.

Figure 72. CMA-CGM, North European Service – French Asia Line 1 (FAL1) ***(source: CMA-CGM)***

Figure 73. CMA-CGM, Adriatic Service, Phoenician Express (BEX2) ***(source: CMA-CGM)***

Figure 74. CMA-CGM, Black Sea Service, Bosphorus Express (BEX) *(source: CMA-CGM)*

Figure 75. CMA-CGM, West Mediterranean Service, Mediterranean Club Express (MEX) *(source: CMA-CGM)*

Each of these services consists of a set of ships calling at a regular sequence of ports. The cargo for Europe is therefore sorted according to destination at the point of origin (e.g. Shanghai) and the containers are transported directly to the European gateways. They all pass Suez, but the ships do not terminate there.

The ships arriving in the North differ from the ships arriving in the South, and the schedules which they adhere to are different too. If ship sizes, speeds, ages and load factors are different, then the financial costs and external costs per km are also different. Moreover, these costs are incurred over the full length of the round-trip voyage (from China/Korea/Japan to Europe) and not just on the minor sections between Suez and the European gateways.

A comparison is made below between these four services:

Table 156. Comparison of Service Characteristics, CMA-CGM, Asia Europe *(source: own-source)*

	North Europe	West Med	Adriatic	Black Sea
	FAL1	MEX	BEX2	BEX
Round trip days	70	77	63	77
Frequency per year	52	52	52	52
Ports of call	16	23	16	19
Fleet	10	11	9	11
Ship size (TEU)	11.388	8.400	6.572	6.552
Year built	2009	2010	2010	2010
Speed (knots)	25	24	24	26

Each of the four services offers a weekly frequency, based on fleets of up to eleven ships performing port rotations lasting 63 to 77 days per round trip.

Thus each ship performs approximately five round trips per year. Each service uses new ships, with approximately the same sailing speed.

However, there are important differences between these schedules:

- The ships on the North European service have almost double the cargo carrying capacity of the Adriatic and Black Sea ships; 11.388 TEU versus 6.552 TEU.

- Despite the longer distance to the Northern range, the round trip time for the North European service (70 days) is lower than either the West Med or the Black Sea services (77 days). This is related to the lower number of port calls per rotation and the relative frequency of these calls – a higher proportion of the payload is exchanged per call –.

Two observations can be made:

- Once a shipping service has been set up, the majority of costs are fixed per vessel per year. The capital costs, crew costs and fuel costs are decided. The average cost per container carried depends largely on the capacity utilisation, and relatively marginal cost is incurred per container.

- Given that CMA-CGM (along with most of their rivals) offers a weekly frequency on all four routes, there are no barriers to prevent a shipper switching a container from a North European to a Mediterranean service. This implies that there are strong competitive pressures and a high potential for optimisation.

Whereas companies such as CMA-CGM and Hyundai Merchant Marine run direct services to the Adriatic from the Far East, others use feeder services.

Figure 76. NYK Adriatic Service (ADS1) ***(source: NYK)***

In the case of NYK Line (part of the Grand Alliance) containers for Adriatic are brought to the Italian hub of Taranto, and then transhipped to Trieste, Ravenna or Ancona.

Figure 77. NYK Adriatic Service (ADS2) ***(source: NYK)***

The accompanying ADS2 service provides a similar set of connections to Venice, Koper and Rijeka.

Table 157. Feeder Service in the Adriatic, characteristics based upon Mary Schulte Vessel *(source: NYK)*

	Adriatic
	ADS
Round trip days	7
Frequency per year	90
Ports of call	4
Fleet	2
Ship size (TEU)	1.700
Year built	2000
Speed (knots)	20,5

A feeder network allows the shipping line to carry containers to the Mediterranean on the largest available ships, and to drop them off at hub ports such as Taranto, Malta or Gioia Tauro which have deep water and which minimise diversion en-route to Northern Europe.

Thus, the containers are brought efficiently on large ships to Europe, but the trade-off is that there is an extra port handling cost at the transhipment hub, additional delay waiting for the feeder, and the need to use a small vessel for the final leg of the journey.

Whereas the North European calls can be made using the largest available container ships, the Adriatic calls will involve the use of either a medium sized ship for a direct call, or a large ship plus a feeder ship for the indirect service.

Three service patterns have been identified:

- Main intercontinental services using large (> 10.000 TEU) ships.
- Secondary intercontinental services using medium (4.000-10.000 TEU) ships.
- Feeder services using smaller (1.000-3.000 TEU) ships.

Northern European gateways and Mediterranean hubs (e.g. Taranto, Tanger MED, Algeciras, Malta and Gioia Tauro) are typically served by category 1. South European gateways (e.g. La Spezia, Genova, Fos) are served by a combination of categories 2 and 3.

The key factors behind this port decision are:

- Volume/Scale – larger vessels can only be justified if they can be filled. Therefore, this is related to the hinterland demand and the market requirements in the area covered by each port.

- Port capacity – depth of water and terminal handling capacity impose a constraint on vessel size. Within this category, the following variables are important:

    - Technical condition of the terminal.

    - The transit policies of the Port (customs declaration, inspections, etc.).

    - Services and facilities in the terminal.

    - Degree of saturation (rate of usage of the Port).

    - Port taxes (both Port Authority and terminal taxes).

    - Leverage of the carrier in the port.

    - E-commerce services: shipment instructions, tracking, invoicing and payment, etc.

- Diversion – shipping lines wish to avoid detours from the main coastal lanes through the Mediterranean. Therefore, this is related to the sea distance from the origin to the port and to the proximity of the port to the final hinterland destination.

- Number of port calls – more calls help to fill the ship, but cost time and distance.

- Other factors, such as the following:

    - The carrier is a member of an alliance and the decision of port choice is conditioned by the alliance membership.

    - The door-to-door cargo influence in the Port.

    - The communication, customer service, language, etc., of the Port.

    - Green logistics chain.

Thus it is likely that for the foreseeable future, traffic growth in South East Europe, better port facilities and better inland connections will encourage the use of direct calls over feeders, and that gradually ship sizes and load factors would increase, helping to reduce costs.

Moreover, using the main characteristics of the ship deployment patterns found in the market it is possible to attempt an estimate of maritime costs, and therefore to exemplify the difference in maritime transport cost between a North European or a South European port call.

Studies such as SONORA (*South North Axis, 0.5.4.8 – Venice Port Authority Business Case – New EU Freight Corridors in the area of Central Europe, Prepared by Transport, Territory and Logistics Research Unit of University IUAV of Venice*) compare the North/South transport economics on the basis of the distance from the Suez canal to the European gateway port, and thus conclude that the nearer Southern ports offer lower costs and lower externalities. However, although it is possible today to operate schedules as SONORA envisages where European containers would be transhipped at Mediterranean hubs such as Port Said, the major carriers on the Asia-Europe trade lane often choose not to organise their transport this way. In the circumstances it seems preferable to compare alternatives based on typical practices.

Since the different coastline areas are served using different service configurations, these differences need to be reflected across the full extent of the voyages, and not limited to the European legs. Without considering the operational structure of the container services (frequencies, port calls and ship selection) it is not possible to comment on the potential cost savings quay to quay.

Thus instead, a scheduled-based analysis has been made using a more standard approach. Similar approaches have been applied in many other models and studies including:

- LINCOST – MDS-Transmodal, UK (*Garratt M, LINCOST Model*).
- Components of Liner Service Costs – Martin Stopford (*Stopford M, "Maritime Economics", Second Edition, Page 352, Based on inputs from Drewry Shipping Consultants*).
- EPEC Consortium – GHK Consultants (*EPEC Consortium, Preparation Study for an Impact Assessment of the Future Guidelines on State Aid of Port Infrastructure, 2008, on behalf of DGTREN*).

Four different call patterns have been modelled, based upon a simplification of the services listed in Table 156 above. The costs of these services are based upon applying text-book ship cost assumptions within NEA's worldwide network models, so the outcomes are generic, and should not be attributed to any specific company's operations. NEA is a member of Panteia, an American Consultancy offering a full range of services in policy research and consultancy and marketing research.

Table 158. Modelled liner services *(source: own-source)*

	Service frequency	Voyage length (km)	Voyage length (days)	Number of ships
1. Asia – North Europe	Weekly	43.422	66	9
2. Asia – West Med	Weekly	35.832	59	8
3. Asia – Adriatic	Weekly	32.918	50	7
4. Adriatic Feeder	Twice weekly	-	-	-

For the three long distance services (1-3 in the table above), a similar pattern of port calls has been assumed East of Suez, so that most of the differences arise from the European call patterns and not the port calls in Asia. This results in shorter voyage lengths, and fewer ships for the West Med and Adriatic routes, compared to the current CMA-CGM schedules (for example). This simplification makes it possible to compare the effect of varying the European calling pattern alone. On the shorter Adriatic route, the distance saved allows the shipping line to reduce the fleet from 9 ships to 7 shops and still provide a weekly service.

Port to port distances have been calculated directly from a network model routeing the ships via Suez, and the sailing speeds and port dwell times have been set to approximate known schedules. For example, CMA-CGM's FAL1 schedule shows a fifteen day sailing time on the main Asia-Europe link between Port Klang (Malaysia) and Tanger MED (Morocco), for a distance of 6.758 nautical miles, implying an average sailing speed of 18,77 knots (nautical miles per hour). The sailing speed has an important effect upon fuel consumption, round trip voyage time and emissions.

Results were calculated using a sensitivity analysis for a range of ship sizes and load factors, and expressed as the full cost per TEU carried, covering:

- Capital costs (purchase and financing).
- Crew costs.
- Fuel – main engine and auxiliary fuel.
- Port dues and terminal handling costs.
- Insurance, maintenance, administration.
- Container costs.

In the sensitivity analysis carried out, five ship sizes and three load factors were used for each service. In our central scenario, the following were selected:

- Asia – Far East: 12.500 TEU vessel and 75% load factor.
- Asia – West Med: 8.500 TEU vessel and 75% load factor.
- Asia – Adriatic: 6.500 TEU vessel and 65% load factor.

Full results are shown below, with the main scenario settings highlighted in bold.

Table 159. Liner service cost analysis *(source: NEA)*

Asia-North Europe	**Cost (US$) per TEU**	**Load factor**		
	Ship size (TEU)	**0,65**	**0,75**	**0,85**
	4.500	1.866	1.646	1.477
	6.500	1.618	1.431	1.288
	8.500	1.464	1.297	1.170
	10.500	1.356	1.204	1.087
	12.500	1.275	**1.133**	1.025
Asia-Adriatic	**Cost (US$) per TEU**	**Load factor**		
	Ship size (TEU)	**0,65**	**0,75**	**0,85**
	4.500	1.476	1.308	1.179
	6.500	**1.287**	1.144	1.034
	8.500	1.169	1.041	944
	10.500	1.086	970	881
	12.500	1.025	916	834
Asia-West Med	**Cost (US$) per TEU**	**Load factor**		
	Ship size (TEU)	**0,65**	**0,75**	**0,85**
	4.500	1.716	1.516	1.363
	6.500	1.490	1.320	1.190
	8.500	1.350	**1.199**	1.083
	10.500	1.252	1.114	1.008
	12.500	1.179	1.050	952

In any given cell (e.g. 4.500 TEU, 65% load factor), the highest costs are found in the North European service, with the West Mediterranean service next, and the Adriatic service having the lowest cost. This outcome arises because the distances and the number of ships required are higher for the North European services, all things being equal. However, the differences are relatively small (around US$300 per TEU) because at a global scale, the extra distance from Italy to Spain and to Germany is relatively small compared to the main part of the voyage across the Indian Ocean to China.

Furthermore, when the adjustments for ship size and load factor are made it then appears that the final quay-to-quay costs for all three services are quite similar, implying that the combination of scale and port capacity in the North and West of Europe, permitting the use of larger ships, compensates for the additional distance to these ports.

Taking into account realistic ship sizes, as well as the load factor adjustment for the Adriatic route, we estimate that the costs of the North European service and the West Mediterranean service are very similar (within US$100 of each other), while the Adriatic service costs an additional US$100 - $150 per TEU.

In conclusion, this shows that although the Southern European ports show advantages in terms of costs with respect to the Northern European ports, the fact that the hinterland market demand is in the North of Europe implies that economies of scale and load factors reverse the situation and makes the North election cheaper for carriers.

Using the same liner service modelling approach, the emissions of carbon dioxide at sea are also calculated here in order to take into account the growing influence of sustainability in the maritime transport of goods. The literature on maritime emissions is at an earlier stage of understanding in comparison with inland modes, so the calculations were made for specific container ships, where good technical data on fuel consumption was available. Fuel consumption estimates were then calculated within the liner shipping model, so as to be consistent with the cost calculations, and these were converted into grams of pollutants and monetised quantities.

Standard averages for CO_2 emissions in shipping can be found in the report "Measuring and Managing CO_2 Emissions" prepared by Heriot Watt University (UK) on behalf of the European Chemical Industry Council, quoting figures from the UK's Department for Environment Food and Rural Affairs (DEFRA) and from the BSR/Clean Cargo study. A figure of 11,5 grams of CO_2 per tonne kilometre is quoted, approximately equal to 100 grams of CO_2 per TEU km.

In comparison with inland transport modes, this is a low rate of CO_2 emission; five to ten times lower than road for example.

Table 160. Averages of grams of CO_2 per tonne kilometer, by mode *(source: DEFRA)*

Grams of CO_2 per tonne kilometre	Lower bound	Upper bound
Road	59	109
Rail - Electric	1,8	19
Rail – Diesel	21	55
Waterway	28	35
All Maritime	5	20
Large container ship	11,5	

It is not to be neglected however, because it is being applied over long distances. Using average emission rates a sea journey of 20,000 km, such as China to Europe implies an average of 2.000 kg of CO_2 per TEU carried. However, schedule characteristics, engine specifications and ship size influence the level of emission, so this has been modelled in more detail for the Asia-Europe route.

Three ships were examined in detail: Maersk Salalah, Maersk Damietta and Emma Maersk.

Table 161. Ships analysed *(source: own-source)*

	Year built	Dwt (tonnes)	TEU
Maersk Salalah	2008	102.367	8.379
Maersk Damietta	2008	68.463	5.085
Emma Maersk	2006	156.907	15.550

The calculations used were adapted from "EcoTransit World – Ecological Transport Information Tool for Worldwide Transports – Methodology and Data" (2010, IFEU Heidelberg, Öko-Institut, IVE/RMCON). Specific fuel consumption (g/kWh) was calculated from available vessel characteristics, combined with the required engine power per TKm. This results in a vessel specific fuel consumption expressed in g/TKm, This consumption rate is then combined with emission factors, resulting in CO_2/CH_4/N_2O/NO_x emission rates for the vessel's main engine.

Table 162. CO_2 emissions from main engines *(source: own-source)*

	Maersk Salalah	Maersk Damietta	Emma Maersk
Fuel consumption at NCR (tonnes/day)	245	160	350
Specific fuel consumption (g/kWh)	165,25	180,10	171,00
Required engine power per TKM (kWh/TKm)	0,0183	0,0164	0,0140
Vessel specific fuel consumption (g/TKm)	3,0305	2,9592	2,3869
Main engine emission, CO_2 produced	9,4382	9,2161	7,4339

consuming HFO (g/TKm)			

Comparing the Emma Maersk to the smaller (and newer) Maersk ships, the rate of CO_2 emission per tonne kilometre is 21% lower.

Comparing a North Europe service with a shorter Adriatic service (see Table 158) a shipping company needs to have nine ships deployed on North Europe compared to seven ships on the Adriatic route in order to maintain a weekly frequency. Nine E class ships produce a similar level of CO_2 emissions to seven smaller ships, per tonne kilometre. Therefore, the scale compensates for the distance. If higher load factors can be achieved on the North Europe services because of the trade patterns, and more equal trade balance, the North Europe service becomes the less polluting alternative.

Table 163. CO_2 emission analysis *(source: NEA)*

Asia-North Europe	**CO_2 Kg per TEU**	**Load factor**		
	Ship size (TEU)	**0,65**	**0,75**	**0,85**
	4.500	2.605	2.257	1.992
	6.500	2.167	1.878	1.657
	8.500	1.895	1.642	1.449
	10.500	1.705	1.478	1.304
	12.500	1.563	**1.354**	1.195
Asia-Adriatic	**CO_2 Kg per TEU**	**Load factor**		
	Ship size (TEU)	**0,65**	**0,75**	**0,85**
	4.500	1.987	1.722	1.520
	6.500	**1.653**	1.433	1.264
	8.500	1.446	1.253	1.106
	10.500	1.301	1.127	995
	12.500	1.192	1.033	912
Asia-West Med	**CO_2 Kg per TEU**	**Load factor**		
	Ship size (TEU)	**0,65**	**0,75**	**0,85**
	4.500	2.329	2.018	1.781
	6.500	1.937	1.679	1.482
	8.500	1.694	**1.468**	1.296
	10.500	1.524	1.321	1.166
	12.500	1.397	1.211	1.068

The implication is similar to the cost calculation. In any given cell (e.g. 4.500 TEU ship with 65% load factor) the highest emissions occur on the North European service, followed by the West Med, followed by the Adriatic. However, when realistic scale effects are taken into consideration, the order is reversed.

Again, here is proved that if the Southern European ports could improve the road and railway connections to the North of Europe or if the Southern Europe hinterland demand could increase (higher load factors and vessel size), then the South would improve clearly with respect to the North. However, the current situation of European economy provokes that a 75% of the containerized cargo transported from mainland China to Europe is unloaded in the Northern European range of ports.

If we focus now on the Mediterranean Europe, when selecting a destination port carriers state that the decision depends on two variables: “hardware” and “software”. The hardware is related to the port facilities, the connections to the hinterland, infrastructure condition, etc.; while the software is related to the way of working of each port, its tracking capability, management, etc. It is evident that a port having a good software but not so good hardware means it can release cargo smoothly but it has not enough facilities to arrange it. On the other hand, a port having a good hardware but not so good software means it will have problems when unloading and loading the cargo. Therefore, both hardware and software must be in equilibrium.

After interviewing some of the main shipping companies transporting containers from mainland China to European Mediterranean ports, it is concluded that Italian ports (Genova, Livorno, La Spezia, Napoli, Gioia Tauro) should improve their hardware. Some of these ports have problems with their equipment facilities or railway connections. Their main problem is that they cannot combine the local cargo distribution with the transhipment distribution. For example, Gioia Tauro and Taranto are pure transhipment ports, while La Spezia, Genova, Livorno, etc. are pure local cargo ports.

On the other hand, Spanish ports like Valencia and Barcelona combine efficiently the local cargo distribution and the transhipment services because both are important for them. Almost all the shipping lines call these two ports because they have good connections to everywhere, especially to Africa. However, the problem of these Spanish ports is the software: customs offices have different and very complicate policies. And also another important service to improve from these ports is the business manners: for the transhipment activities from Valencia and Barcelona now you need the support of local companies because they do not have an international view. In conclusion, although Barcelona and Valencia ports hardware is good enough, the local business efficiency is not high enough. This is also related to the congestion problems noticed by some carriers in these ports: sometimes they have to wait outside the port for one day or more. This specially affects Valencia, which in the past years has been a busy port, which implies that a sudden unexpected increasing demand could not be processed in time because of its high degree of saturation. However, it seems that the situation in terms of saturation in Barcelona and Valencia now is better because the volume handled has been significantly reduced due to the economic crisis.

In addition, Greek and Turkish ports have a special advantage because of their good location. That is why some carriers like COSCO have invested a lot of money there in the past few years. They think that in the future the Black Sea market will be very important because it will be well connected by railway and road to Central Europe. However, some carriers have suggested that Piraeus should improve its reliability – it has a bad reputation of successive strikes that completely stopped its operations for long periods of time – and that Ambarli should improve its berthing facilities – the terminal is not up to date in terms of the facilities, in comparison to the importance it has gained in the past few years –.

On another hand, from the interviews it has been noted that in Marseille Fos there are a lot of problems concerning the labour conditions, which implies that a large number of working days the Port is not operating properly. From the carriers point of view this is an important issue because they operate from mainland China and they cannot do anything about it.

Finally, an important port today when exporting containers from mainland China to North Africa is Tanger MED. After the interviews it was noticed that the loading and unloading capacity of the port is not good enough because its facilities are quite old.

To sum up, if the mentioned ports could improve their weaknesses, probably the current situation of the container flow from mainland China to Europe would change significantly. Nevertheless, the cost and the location of the consumption market – customers – will be always the most important decision variables for carriers when selecting a destination port in Europe.

In summary, these are the main conclusions when analysing the current situation of exports of containerized goods from mainland China to Europe:

- The hypothesis that shorter sailing distances between Mediterranean ports and East Asian ports ought to create a competitive advantage relative to Northern ports is not supported by this analysis.

- Instead, volume and scale create efficiencies which, being applied to the entire service and not just the European calls; reduce the unitary cost of the voyage around the Atlantic coast of Europe.

- In the North, the lines can combine scale (largest available ships) with direct calls in the Hamburg and Le Havre range. In the South the lines use well-located hubs (Egypt, Malta, Morocco, Southern Italy, Southern Spain) plus feeders, or medium to large sized mother ships for direct calls. They encounter a compromise therefore, either by adding a feeder leg, or by limiting the vessel size.

- Competitive dynamics in the shipping industry play an important role. Large ships and high load factors offer lower unit costs. Companies have a strong incentive to introduce new ships and to fill them, leading to cycles of low rates and over-capacity. Consequently shippers have a choice. It is therefore reasonable to expect efficient network operations and efficient port choices.

- Cost modelling exercises based on realistic shipping schedules indicate that maritime costs are similar for Northern and Southern port calls. However, the use of ships greater than 11.000 TEU on North European services confers a cost advantage on these routes.

- External cost modelling analyses show that the scale and load factor apply in a similar fashion. Despite the longer voyages, the ability to use larger ships on northern routes is a compensating factor. With higher load factors, the northern routes offer lower externalities per tonne kilometre.

European transport policy seeks to balance internal and external costs, taking into account both inland and maritime transport. DG-CLIMA states that the European Union is committed to an international effort to reduce greenhouse gases from shipping, given that 40% of international shipping is related to European economic activity.

The 2011 White Paper states in its first paragraph:

Transport is fundamental to our economy and society. Mobility is vital for the internal market and for the quality of life of citizens as they enjoy their freedom to travel. Transport enables economic growth and job creation: it must be sustainable in the light of the new challenges we face. Transport is global, so effective action requires strong international cooperation.

Port policy influences economic development, and shipping is a relatively sustainable form of transport. One of the questions addressed within this study is whether existing patterns of cargo distribution within long distance container shipping are efficient. The answers can be summarised in figures comparing the internal and external costs, for Northern and Southern routes, for a series of European destinations. They conclude that market incentives, which lead to a clustering of port volumes in the Northern range, are consistent with economic and social objectives.

In the following figures, internal and external costs by land and sea are compared for a Chinese container transported to four European destinations: Dusseldorf, Frankfurt, Stuttgart and Innsbruck.

Despite longer sea distances, the point of equality is found close to the Northern edge of the Alpine arc. The ability to offer scale in shipping, critical mass in ports and effective multimodal inland transport offsets distance.

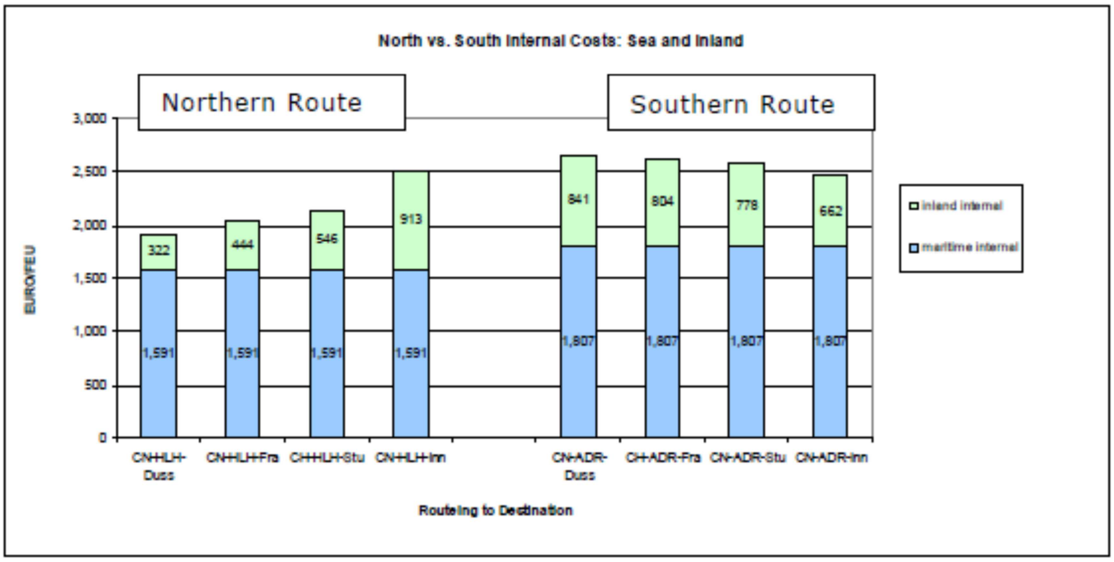


Figure 78. Internal costs for a range of European cities *(source: NEA)*

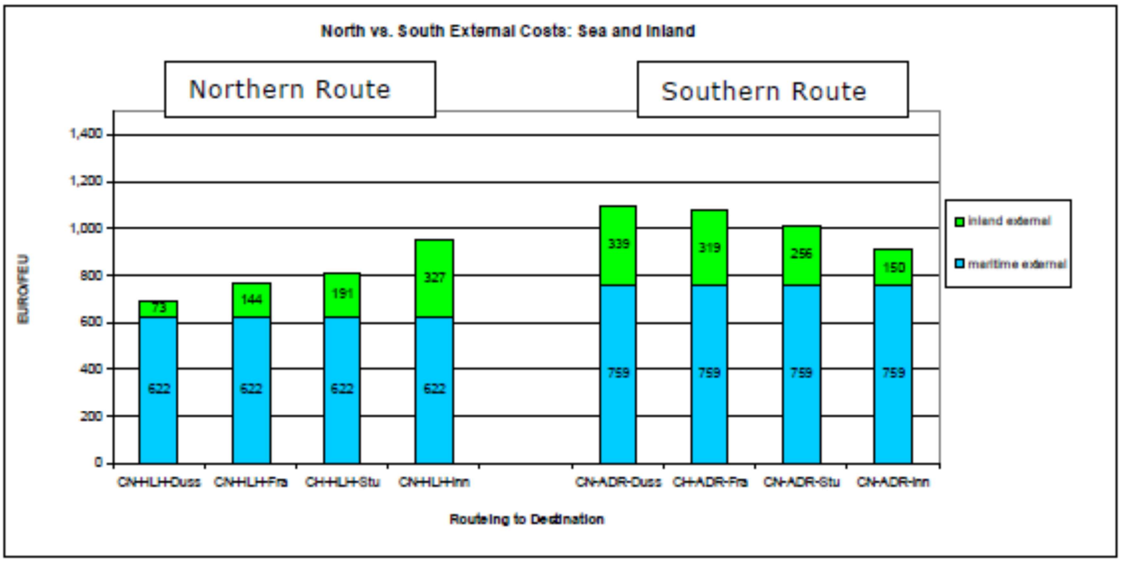


Figure 79. External costs for a range of European cities *(source: NEA)*

In the left side of the chart, costs are estimated for containers shipped from China via a Northern European port. The four bars show how the costs change as the inland destination shifts southwards from Dusseldorf to Frankfurt to Stuttgart to Innsbruck. On the right hand side, the port of entry is assumed to be an Adriatic port.

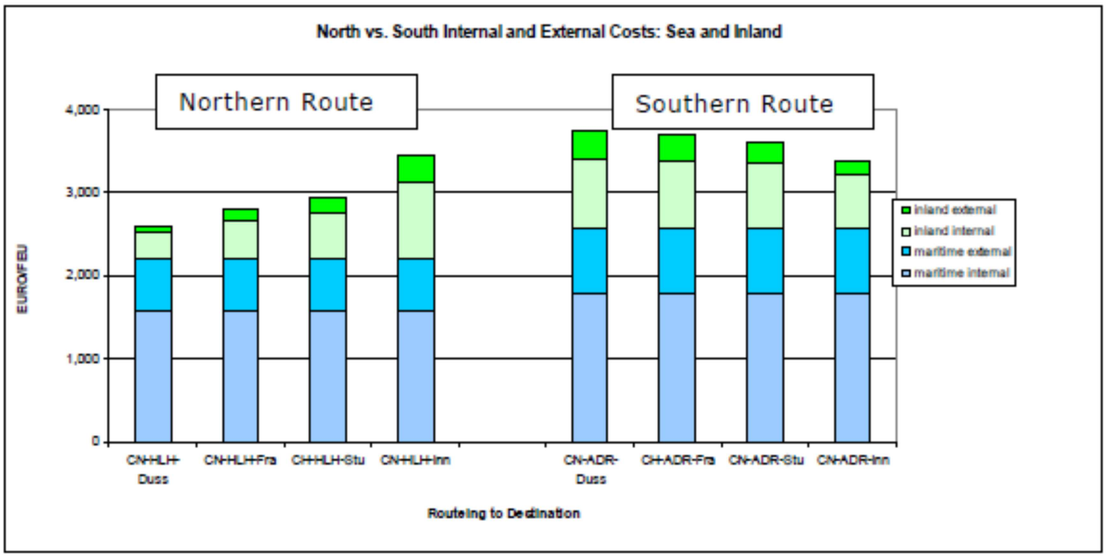


Figure 80. Total land and sea costs for a range of European cities *(source: NEA)*

Figure 80 summarises all the maritime and inland external and internal costs estimated within this study. Several observations can be made:

- Overall, the maritime internal and external costs are low given the long distances involved. In each case, a sea journey of around 20.000 km is being modelled.

- Given current valuations of externalities, internal costs outweigh external costs.

- Internal and external costs are correlated; both react positively to distance, and negatively to load factors and scale.

- Load factors and scale effects can be significant enough to outweigh distance; this is the main reason why the analysis shows lower overall costs via the Northern range.

- Load factors and scale operate on both intercontinental maritime and inland/feeder networks.

- Concentrated flows at major hub ports help these scale and load factor effects to be realised.

This study suggests that within this specific sector of the freight market there has been a broadly rational evolution, without major barriers or conflicts between economic interests and sustainability. Although Europe's external trade has shifted markedly towards Asia and thus towards Suez, its internal economic geography and transport infrastructure has changed only gradually, and the greater responsiveness of maritime transport appears to be the decisive factor.

2.4. A detailed analysis of the maritime trade between mainland China and Spain

The total maritime transport of goods from Spain, as it is shown in Figure 81, had an important drop down in 2009 due to the effects of the European economic recession. That year the maritime transport of goods from Spain decreased from more than 400 million tonnes to 350 million tonnes and this decrease was larger in the imports than in the exports. However, from 2009 to 2012 it increased gradually until reaching again the 400 million tonnes. This rise in the maritime transport of goods in this period was thanks to the increase in the exports, as the import values remained more or less constant after the 2009 drop down (see Figure 83 and Figure 84).

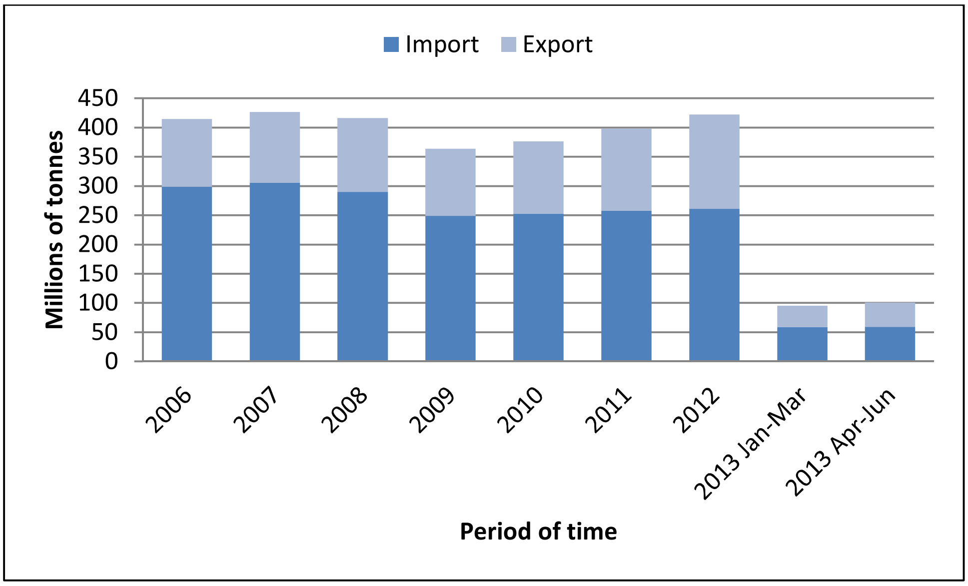


Figure 81. Total maritime transport of goods from Spain (*source: own-source using Eurostat data*)

Concerning the total maritime transport of goods from Spain with mainland China, the tendency is similar to that of Spain with the rest of the World: there was an important drop down in 2008 and 2009 due to the effects of the European economic recession, when the maritime transport of goods from Spain with mainland China decreased from more than 20 million tonnes to 10 million tonnes. However, and same as before, from 2009 to 2012 it increased gradually until almost reaching 15 million tonnes, still below the 2007 values (Figure 82). This rise in the maritime transport of goods with mainland China in 2009-2012 was thanks to the increase in the exports, as the import values remained more or less constant after the 2008-2009 drop down.

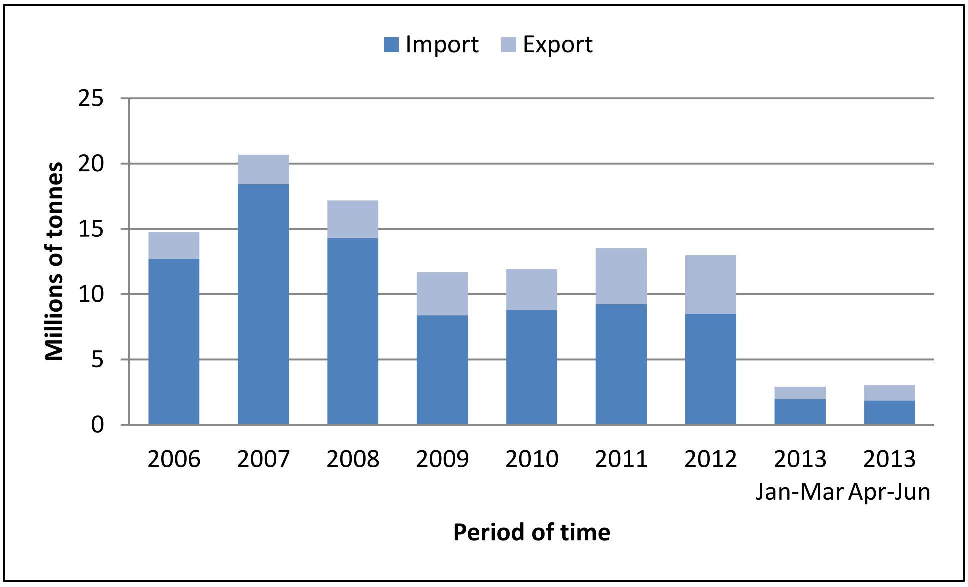


Figure 82. Total maritime transport of goods from Spain with mainland China (*source: own-source using Eurostat data*)

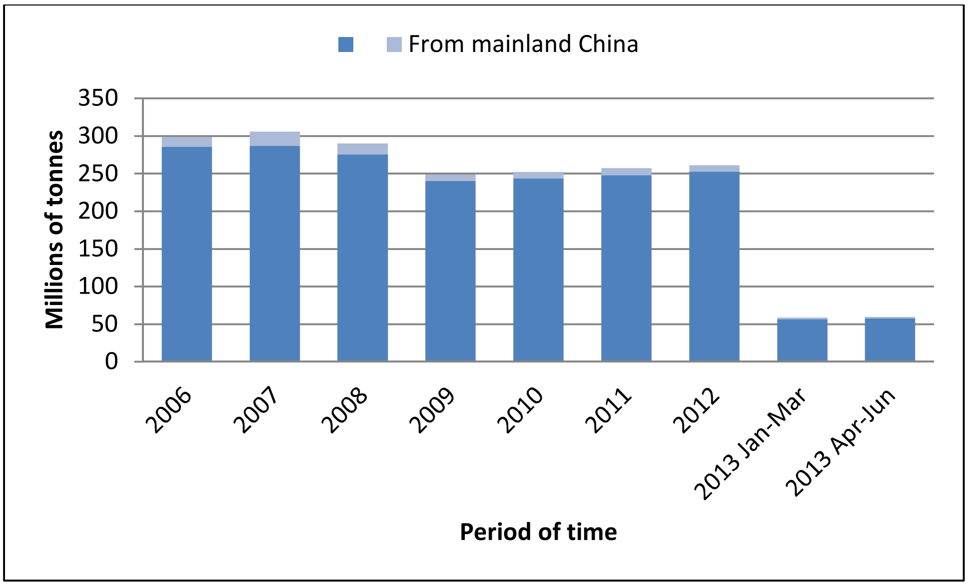


Figure 83. Maritime import of goods from Spain (*source: own-source using Eurostat data*)

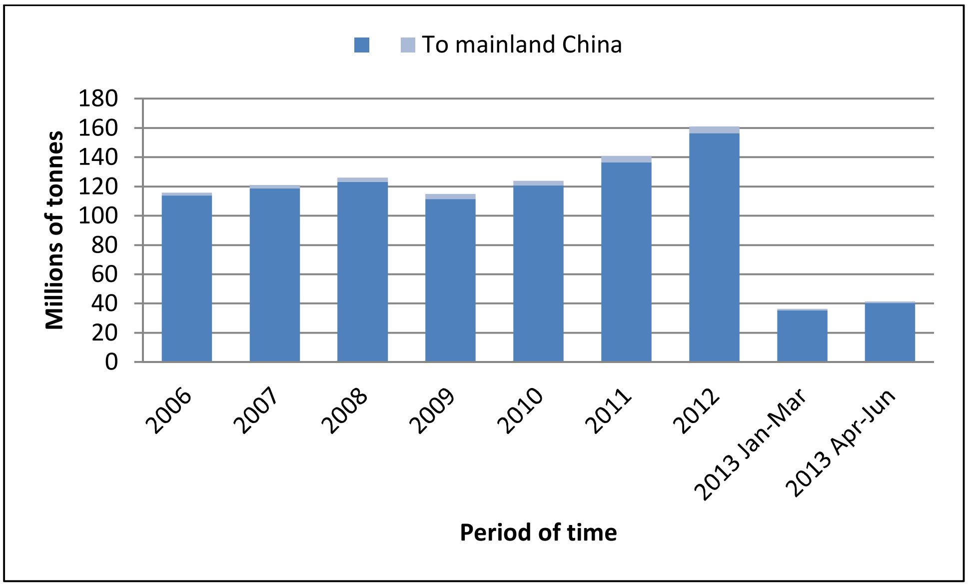


Figure 84. Maritime export of goods from Spain (*source: own-source using Eurostat data*)

Inside Spain, it is relevant to distinguish between the Mediterranean and South Atlantic area and the North Atlantic area. As in this study we are focused on the Mediterranean European ports, in this section the influence of the Mediterranean and South Atlantic ports of Spain will be analysed related to the whole Spain. As it can be seen in Figure 85, the Mediterranean and South Atlantic area plays an important role in the total maritime transport of goods from Spain (78% in 2012). This influence is bigger in the exports (84%) than in the imports (74%), but has been increasing slightly since 2006. When the commercial partner of Spain is mainland China, this influence increases to a 93% (96% for exports and 92% for imports), as seen in Figure 86.

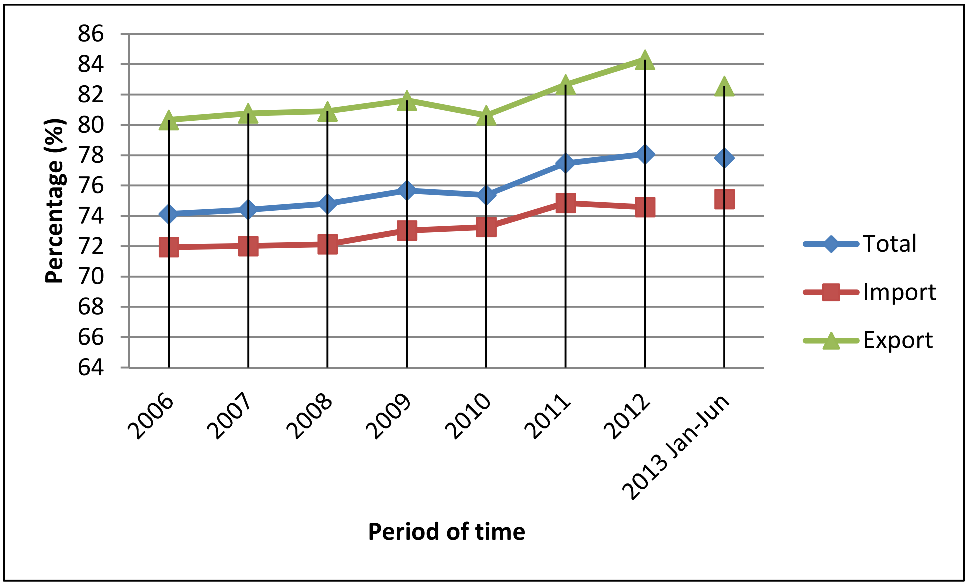


Figure 85. Percentage of the total transport of goods from the Mediterranean and South Atlantic area of Spain with respect to the total Spain (*source: own-source using Eurostat data*)

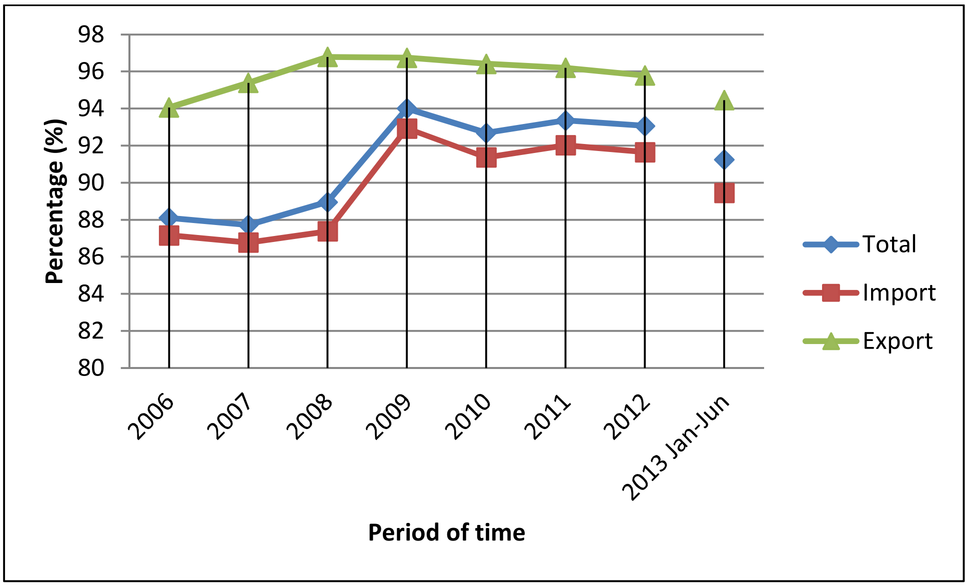


Figure 86. Percentage of the total transport of goods from the Mediterranean and South Atlantic area of Spain with mainland China with respect to the total Spain with mainland China (*source: own-source using Eurostat data*)

Among the total imports from Spain, in 2012 the largest share was for liquid bulks (52,2% of imports), followed by dry bulks (31,6%) and finally, general cargo (16,2%). In 2012 liquid bulks imports fell by 1,2%, totaling 98,9 million tonnes and general cargo also fell by 7,3%, moving 30,6 million tonnes. Meanwhile, dry bulk imports increased by 7,7%, to 59,9 million tonnes.

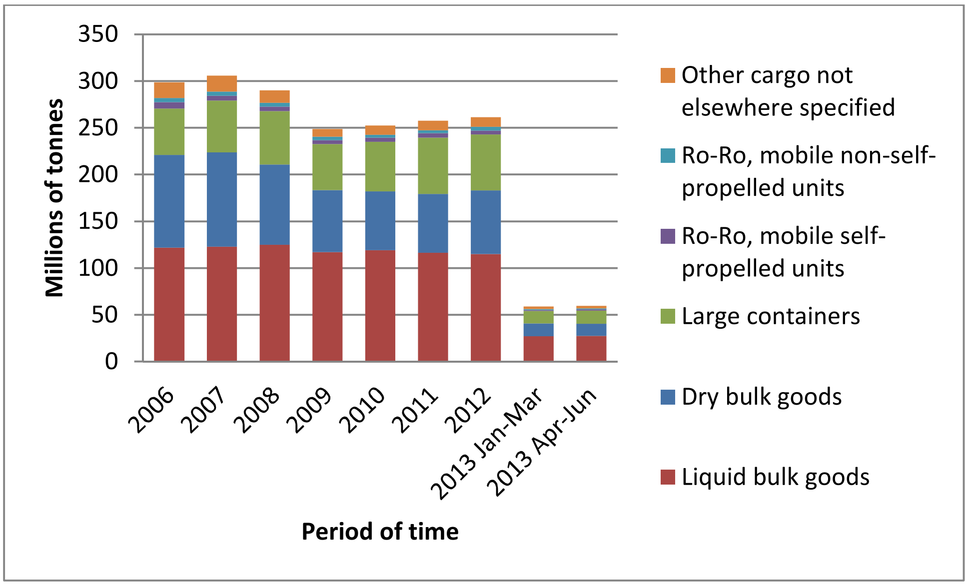


Figure 87. Type of cargo imported from Spain (*source: own-source using Eurostat data*)

In exports, general cargo (both conventional and containerized) accounted for 55,2% of the total trade, with 48,2 million tonnes (+5,6%). Liquid bulks, which grew by 30,6% to 23,7 million tonnes, accounted for 27,1% of exports and dry bulks the remaining 17,7%, moving 15,4 million tonnes, with a remarkable increase (+43,4%).

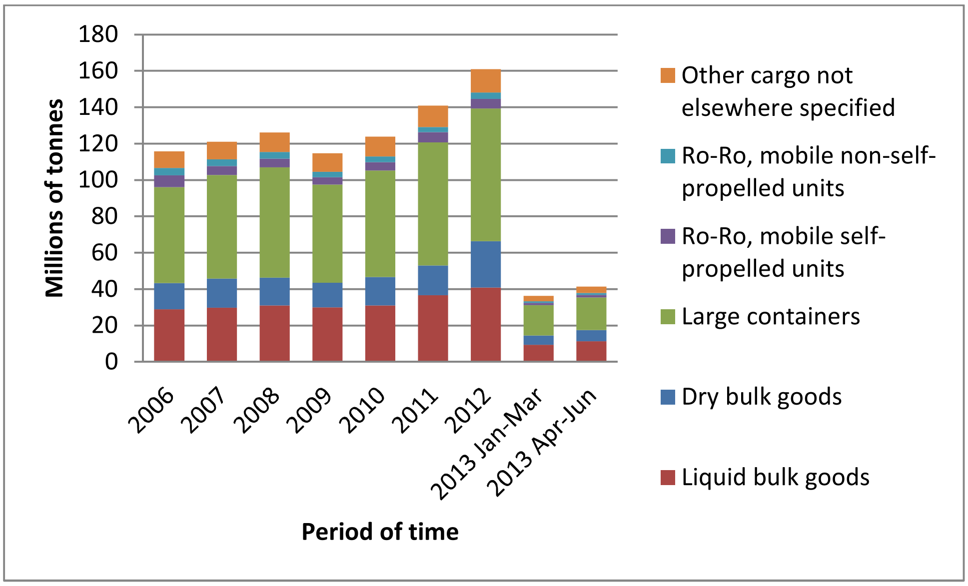


Figure 88. Type of cargo exported from Spain (*source: own-source using Eurostat data*)

As in 2011, in 2012 weak domestic demand forced the Spanish producers to find markets abroad. As a result, in the last five years, exports by sea have increased by 42,6%, while imports and cabotage trades are at levels of 2001/2002.

When the commercial partner is mainland China, the type of cargo both imported and exported from Spain is basically large containers (Figure 89 and Figure 90). Between 2006 and 2008 the imports of dry bulk goods from mainland China were still relevant, but from 2009 large containers is the main imported and exported type of cargo from Spain. In addition, while the imports from Spain coming from mainland China have been kept constant in the last four years, the exports have increased significantly from 2009 to 2012.

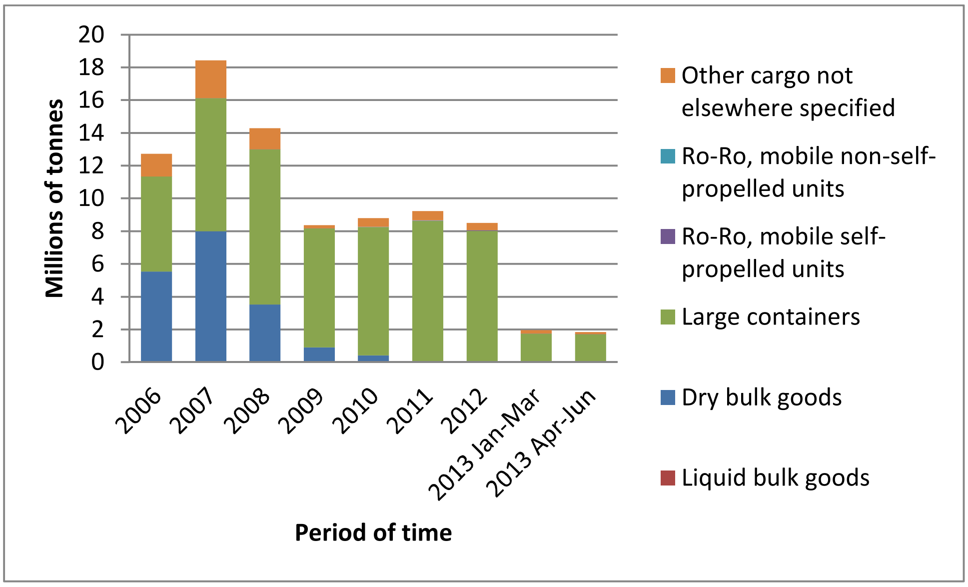


Figure 89. Type of cargo imported from Spain with mainland China (*source: own-source using Eurostat data*)

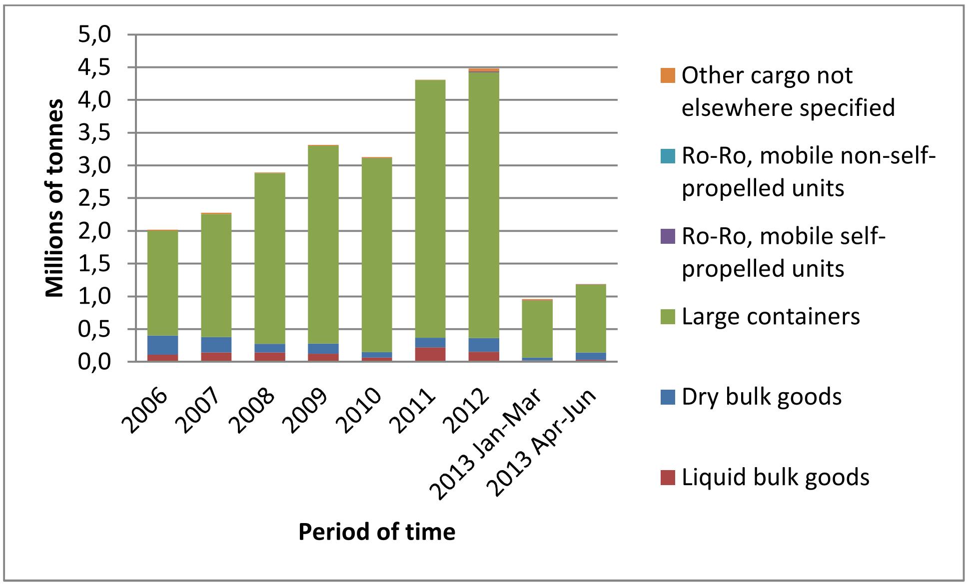


Figure 90. Type of cargo exported from Spain to mainland China (*source: own-source using Eurostat data*)

From now on, the description of the maritime transport of goods between China and Barcelona will be in terms of large containers measured in TEU. The quarterly evolution of the total maritime transport, the total maritime import and the total maritime export of both loaded and empty TEU from Spain from the year 2000 until the second semester of 2013 are shown in Figure 91, Figure 92 and Figure 93, respectively. As it was shown before, in the three cases there was a significant downfall after 2008 due to the European economic crisis, which has been followed by a slightly increase of the transport of TEU in 2010, 2011 and 2012. In addition, it can be clearly seen that the influence of mainland China in the transport of TEU from Barcelona has increased significantly since 2000, both in the imports and the exports sides.

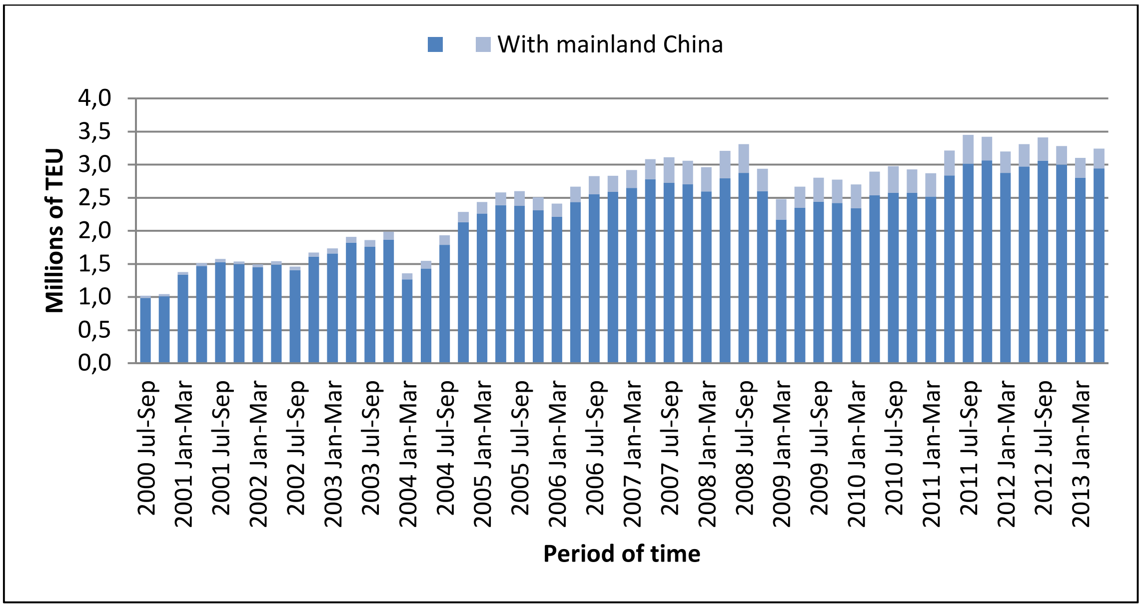


Figure 91. Total maritime transport of both loaded and empty TEU from Spain (*source: own-source using Eurostat data*)

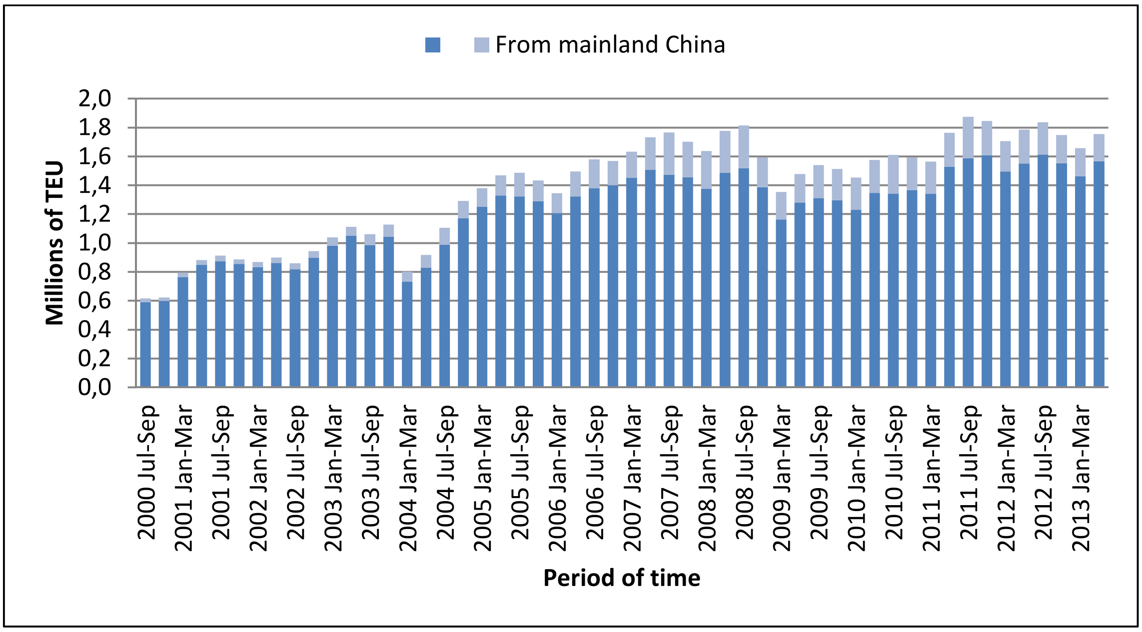


Figure 92. Total maritime import of both loaded and empty TEU from Spain (*source: own-source using Eurostat data*)

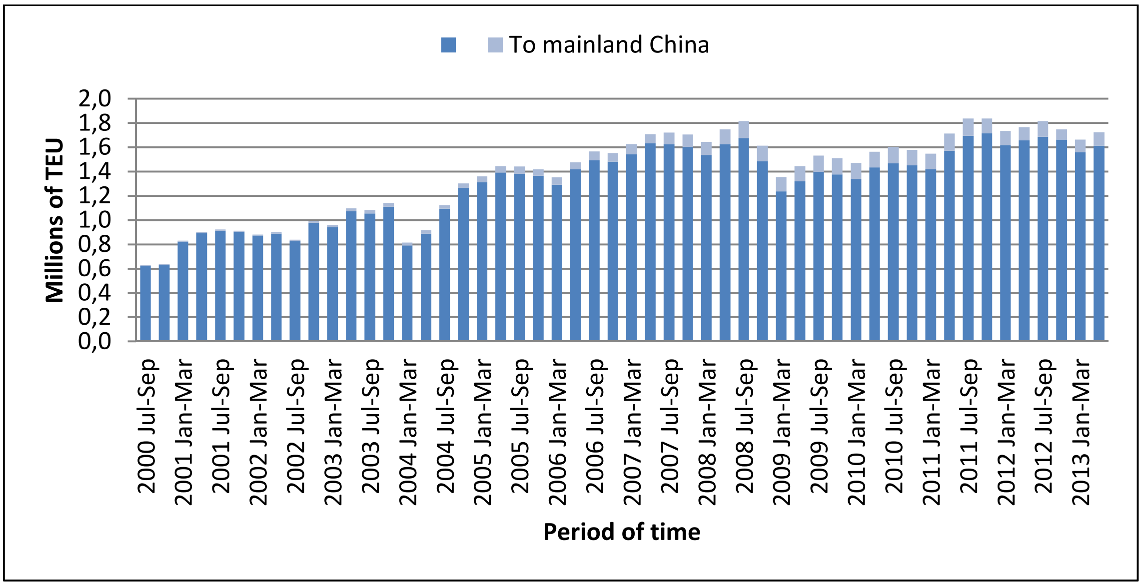


Figure 93. Total maritime export of both loaded and empty TEU from Spain (*source: own-source using Eurostat data*)

When comparing the total gross weight of goods transported from Spain by maritime transport to the same data from the European Union, it can be seen in Figure 94 that Spain represented in 2011 a 12,5% of the whole EU. This percentage has increased in a 0,5% since the previous year, after being decreasing continuously from 2007, showing that the European economic crisis affected more Spain than other countries in the EU.

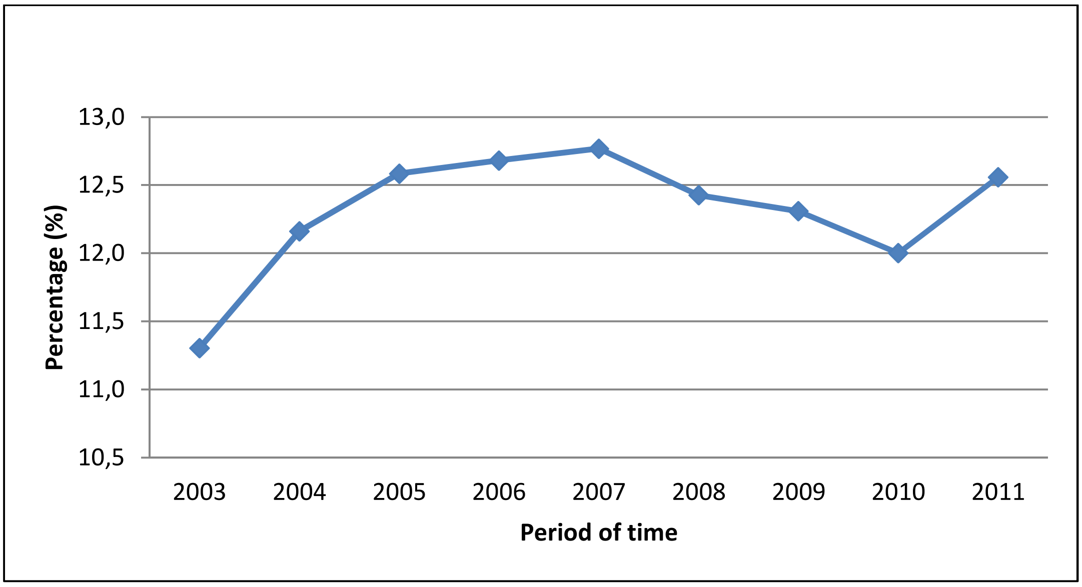


Figure 94. Percentage of the total gross weight of goods transported from Spain by maritime transport with respect to the European Union (27 countries) (*source: own-source using Eurostat data*)

The quarterly evolution of the percentage of the total maritime transport of both loaded and empty TEU from Spain with respect to the European Union from the year 2000 until the second semester of 2013 is shown in Figure 95. It can be seen how the influence of Spain in the EU increased gradually from a 9% in 2000 to a 15% in 2008, before the European economic recession affected especially Spain, reducing its influence (currently a 12%).

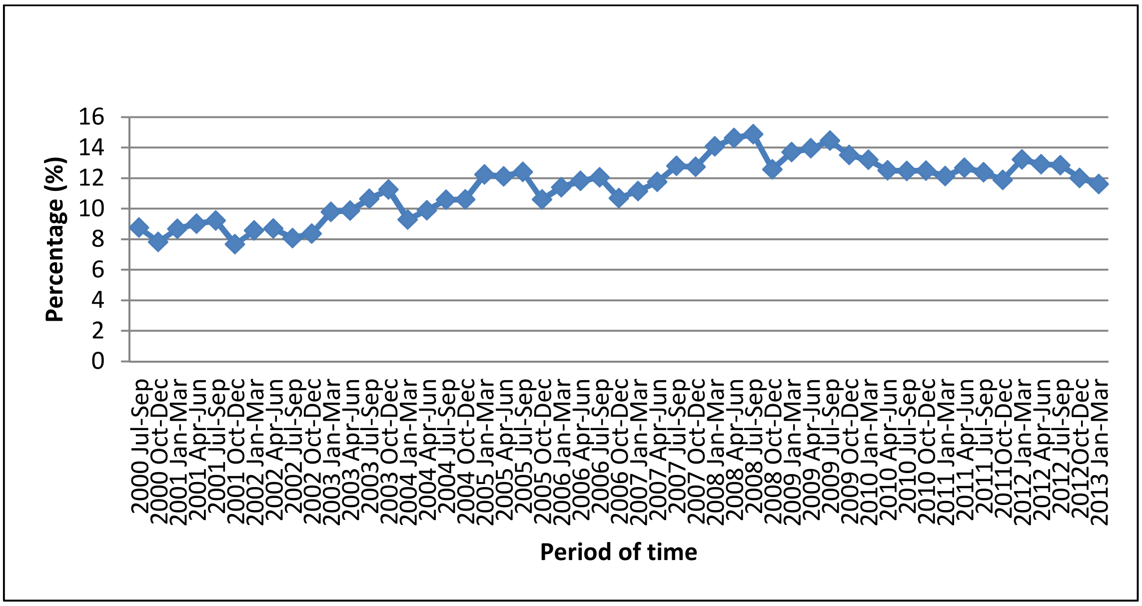


Figure 95. Percentage of the total maritime transport of both loaded and empty TEU from Spain with respect to the European Union (*source: own-source using Eurostat data*)

The quarterly evolution of the percentage of the total maritime import and the total maritime export of both loaded and empty TEU from Spain with mainland China with respect to the European Union from the year 2000 until the second semester of 2013 are shown in Figure 96 and Figure 97, respectively. It can be seen that the influence of Spain in the maritime import of TEU coming from mainland China follows the same pattern as the previous graph: it increased gradually from a 11% in 2000 to a 17% in 2008, before the European economic recession affected especially Spain, reducing its influence (currently a 12%). However, concerning the exports the situation is different: the influence of Spain in the maritime export of both loaded and empty TEU to mainland China increased gradually from a 6% in 2000 to a 14% in 2009, when it decreased to a 11% in approximately one year and after fluctuated between 10% and 14%, currently being 11%.

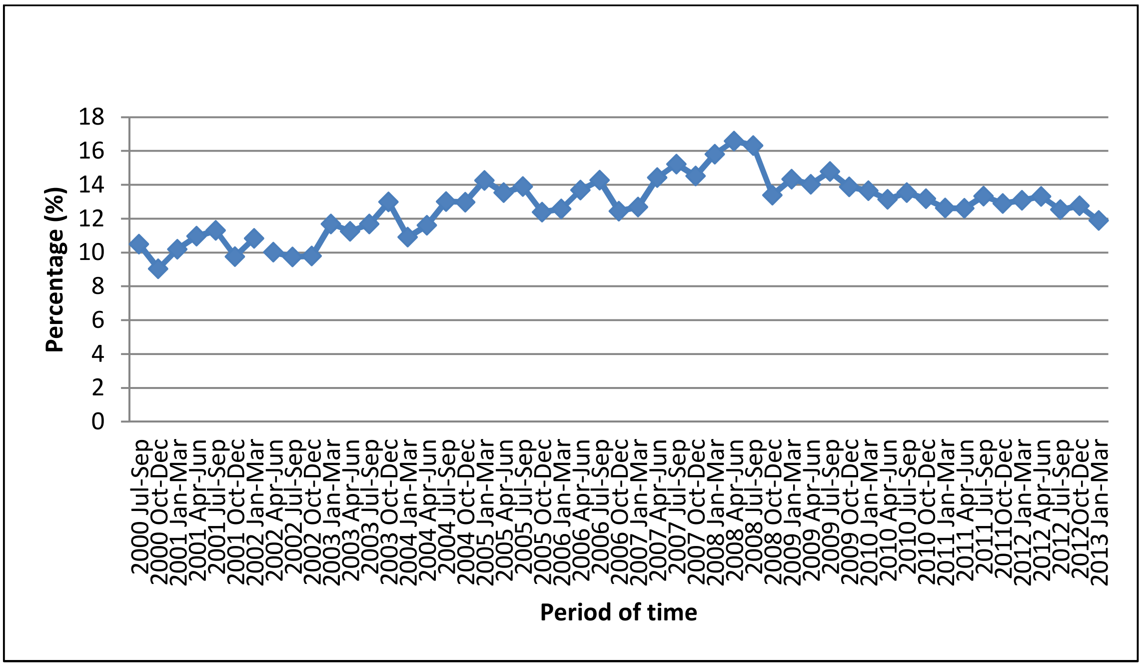


Figure 96. Percentage of the total maritime import of both loaded and empty TEU from Spain coming from mainland China with respect to the European Union (*source: own-source using Eurostat data*)

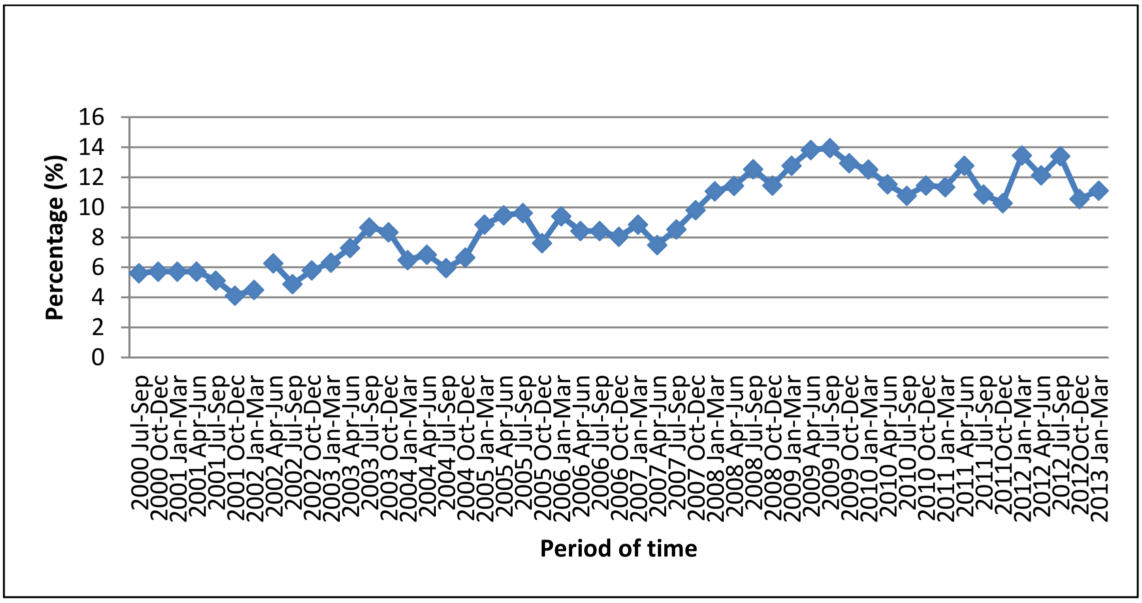


Figure 97. Percentage of the total maritime export of both loaded and empty TEU from Spain to mainland China with respect to the European Union (*source: own-source using Eurostat data*)

Finally, the following two graphs (Figure 98 and Figure 99) show how in Spain the relative importance of imports decreased significantly in the last decade, while the exports increased its percentage among the total. Therefore, while in 2002 in Spain the percentage of the total gross weight of goods handled in Spain that were imported was 74% (the complementary 26% were exported), in 2011 this distribution was 64% imports and 36% exports. On the other hand, in Europe the tendency has been more stable, imports maintaining its percentage among the total gross weight of goods handled at about 63%, and exports at 37%.

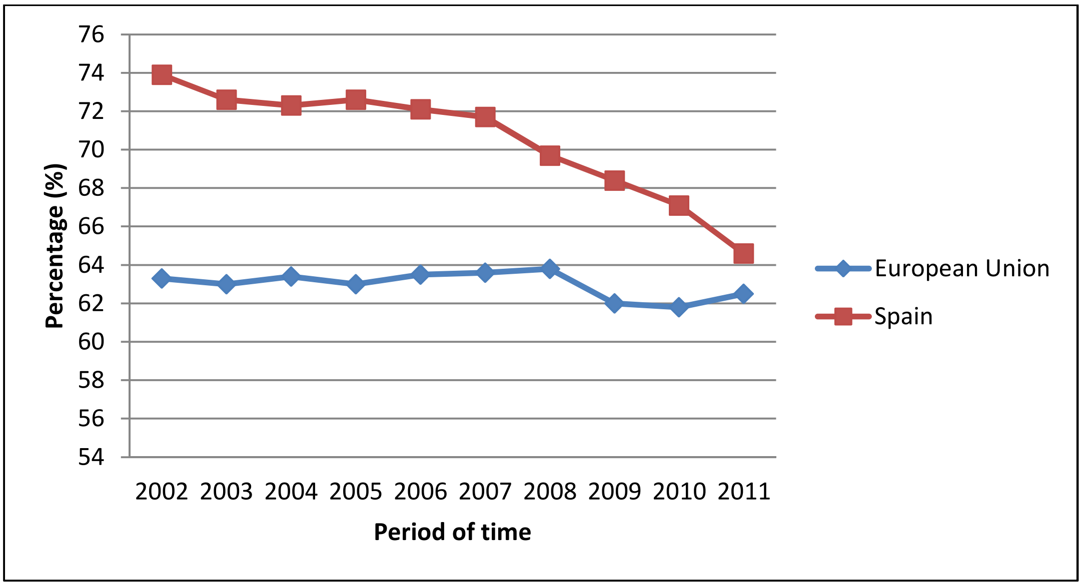


Figure 98. Percentage of the total gross weight of goods handled in Spain and in the European Union (27 countries) that are imported (*source: own-source using Eurostat data*)

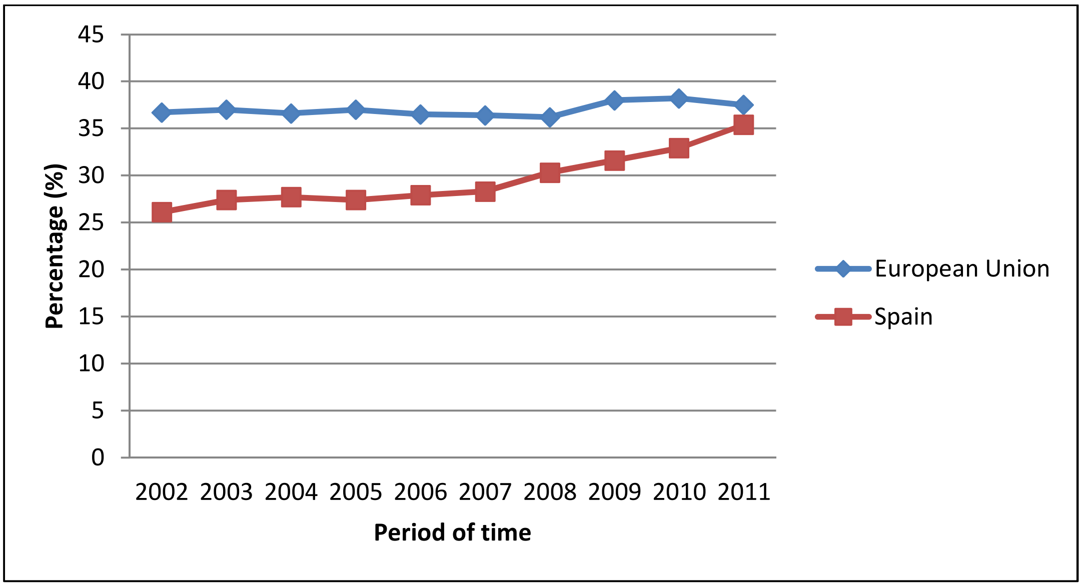


Figure 99. Percentage of the total gross weight of goods handled in Spain and in the European Union (27 countries) that are exported (*source: own-source using Eurostat data*)

In summary, Spain is an important European platform for the import and export of maritime goods, even more when the commercial partner analyzed is mainland China. The Spanish ports of Valencia, Algeciras, Barcelona, Las Palmas and Bilbao have been positioned in 2013 in World's top 125, confirming the strategy carried out by Spain in the global maritime transport.

7,2 million TEU out of more 12,1 million TEU (60%) transported by these five ports (Valencia, Algeciras, Barcelona, Las Palmas and Bilbao) were transshipped, which means that the Spanish ports and logistics facilities are relatively important in the main global maritime routes. This 12,1 million TEU represent the 86% of the total movement of TEU from the Spanish ports, and 2% of the 516,7 million TEU transported from the top 125 ports of the World.

After the Asian countries, the US, Germany and the Netherlands, Spain appears to be at the 11th position in the World rank of total movement of TEU, 3rd in Europe. Moreover, together with Japan it is at the third position as the country that adds more ports to the top 125 ports in the World, and the first one in Europe, in front of the UK (4) and Germany and Italy (3).

Specifically, Valencia is the first Mediterranean port, 5th in Europe and 30th in the World, while Algeciras is the 2nd Mediterranean port, 6th in Europe and 34th in the World. On the other hand, Barcelona is the 7th Mediterranean port, 15th in Europe and 77th in the World. In the north of the Iberian Peninsula, the reference is Bilbao, which is in the 25th position in Europe and 125th in the World. However, another eight Spanish ports (Alicante, Cádiz, Castellón, Málaga, Sevilla, Tarragona, Vigo and Santa Cruz de Tenerife) have developed fast in the past few years and are currently among the first 200 World ports.

Despite all this, there is a high competence between the Mediterranean ports due to its dependence of transits traffic, which has as a consequence important fluctuations in the market shares. For example, last year Málaga and Tarragona reduced its TEU throughput a 30 and a 16%, respectively, while Castellón increased it a 23%.

3. The perspective of carriers

Once the current map of transport of TEU from China to Europe was built, together with the maritime transits and the inland waterways distribution, interviews to the main carriers operating between mainland China and the European Mediterranean ports were carried out.

The aim of the interviews was to identify which are the main priorities of the shipping companies in the exportation from China to Europe.

Objectives:

- To get information about which are the main shipping companies in the exportation of TEU from China to Europe. We are particularly interested in the exports from China to the European Mediterranean ports: Barcelona, Malta, Genova, Gioia Tauro, Fos, Cagliari, Valencia, Tanger MED, Algeciras.

- To have knowledge about the main maritime services from China to the Mediterranean Ports in Europe, their capacity and frequency, as well as the feeder services operating from the hub and spoke ports.

- To understand the rate of leverage of the different shipping companies in the Mediterranean Ports, and its relation to the exports from China to these Ports.

- To determine what are the decision variables for these shipping companies concerning the election of a gateway port or a hub port in Europe.

- To find out the future changes that these shipping companies will introduce in their vessels, the future potential alliances between companies and their intentions of investing in some Mediterranean Ports, in order to get some clues about the future scenarios in the exportation of TEU from China to the Mediterranean Europe.

The interview was targeted to the main shipping companies that operate exporting from China to Europe. The objective was to know more details about their main decision criteria when selecting a European port, and also the main challenges and problems that they encounter. Another objective of this study was to identify the strengths and weaknesses of the main Mediterranean ports concerning the Far East – Europe route via Suez.

The research study was divided into four sections:

- Information about the shipping company (size, revenues, member of any alliance, etc.) (**10 questions**).

- The company's current situation in the export of TEU from China to Europe, focusing on the maritime services operating the Far East-Europe route and the feeder services from the Mediterranean Ports analysed (**13 questions**).
- The future changes that the shipping company will introduce in its vessels, operating terminals, business plan, etc. (**5 questions**).

However, before the interviews were executed, the current situation of carriers in the World and the existing maritime services from mainland China to the European Mediterranean ports was investigated.

3.1. The current situation of carriers in the world

According to Lloyd's Register – Fairplay, as of 1 January 2013, world cargo carrying fleet consisted of 54.859 ships (-0,5% decrease as compared to 1 January 2012), with 1.027.044.761 GT (+3,6%). These figures show a significantly lower growth than it was estimated last fall by Clarkson (6,1%), mainly due to higher scrapping rates, which have exceeded expectations.

The segment of the fleet that registered the biggest increase, in GT, was the bulk carriers fleet (+7,1%) through it cannot be compared to the huge growth experienced in 2011 (+16,9%). Containerships grew by 4,4% as compared to +8,3% in 2011 and the oil tankers fleet increased by 3,1% (6,4% in 2011). Other fleet segments recorded declines of different magnitude: gas carriers (-0,6%), general cargo (-3,7%) and OBO (combined) which were down a remarkable 51,2% and practically do not have any more weight in the world fleet.

The GT distribution of the world merchant fleet by vessel type did not change significantly over the previous year. By the beginning of 2013 35,5% of GT correspond to bulk carriers, 22,8% to oil tankers and 17,5% to containerships.

	1980		1985		1990		1995		2000		2005		2010		2012		2013	
	NS	GRT	NS	GRT	NS	GRT	NS	GT	NS	GT	NS	GT	NS	GT	NS	GT	NS	GT
Oil & product tankers	7.5	201.2	7.1	162.1	6.9	154.5	6.8	159.8	7.3	163.7	7.0	170.9	7.4	209.8	7.4	230.0	7.4	235.7
Gas tankers	0.6	7.4	0.8	9.9	0.8	10.6	0.9	14.0	1.1	17.9	1.2	24.7	1.5	46.1	1.6	50.6	1.6	50.3
Bulk carriers	4.3	83.3	5.0	110.3	4.8	113.4	5.7	129.7	6.1	149.4	6.5	175.8	8.0	250.5	9.7	340.8	10.1	364.9
General cargo	22.7	81.3	21.7	80.1	19.7	72.7	18.9	66.2	18.9	65.6	17.7	59.6	18.6	65.5	17.3	64.3	16.6	62.0
Containerships	0.7	11.3	1.0	18.4	1.2	23.9	1.6	35.1	2.5	55.3	3.2	85.8	4.7	145.5	5.0	171.8	5.0	179.4
Other merchant (*)	6.2	15.4	7.6	18.4	6.8	23.5	8.6	46.2	10.1	63.5	11.4	84.8	13.8	123.2	14.1	133.8	14.1	134.8
TOTAL MERCHANT	42.0	399.9	43.2	399.2	40.2	398.6	42.7	451.1	46.0	515.4	47.1	601.7	53.9	840.6	55.1	991.2	54.9	1,027.0
Other non merchant	31.7	16.3	33.2	17.0	38.0	24.9	38.0	24.8	40.8	28.2	42.9	31.6	48.2	42.1	49.2	51.9	50.1	54.2
TOTAL	73.7	416.2	76.4	416.2	78.2	423.5	80.7	475.9	86.8	543.6	90.0	633.3	102.2	882.6	104.3	1,043.1	105.0	1,081.2

(*) Includes chemical tankers, other tankers, passenger ships, ferries, ro-ros, car carriers, etc.
Figures as of 1 January, except 1980, 1985 y 1990 (figures as of 1 July)
Source: Lloyd's Register

NS: Thousand ships
GRT: Million GRT
GT: Million GT

Figure 100. World merchant fleet by ship types (*source: Lloyd's Register*)

According to ISL Bremen statistics, during 2012, 1.532 merchant ships, with 58,6 million dwt were broken up (2,8% of the fleet), a new record after the 47 million dwt scrapped in 2011, and accounting for 3,8% of the existing fleet at the end of the year. Bulk carriers accounted for nearly 60% of the scrap tonnage, with 596 units and 35,2 million dwt, tankers accounted for 21,9% with 214 units and 12,9 million dwt. Finally, 182 containerships were scrapped, totalling 4,9 million dwt (330.000 TEU) and 8,3% of the number of ships scrapped. It is particularly significant that both, in the bulk carrier segment and in the containerships, the average age of scrapped vessels fell from 30 years in 2011 to just 23 in 2012, while the scrapped oil tanker fleet average age decreased from 25 to 23 years.

During 2012, the addition to the fleet of nearly 150 million dwt of new ships, along with the dismantling of about 59 million dwt, significantly reduced the average age of the world fleet to 17,3 years as compared to 18,7 years a year earlier. Younger segments of the fleet were oil tankers and bulk carriers (both 8,9 years), container vessels (9,9 years), LNG gas carriers (10,2 years), chemical tankers (11,3 years), LPG gas carriers (15,4 years) and Ro-Ro ships (15,6 years). Above the average age of the world merchant fleet were product tankers (20,8 years), general cargo ships (22,4 years), cruises (22,6 years), reefers (24,7 years) and ships (25,2 years).

One more year, Panama remains as the flag with more registered tonnage, with 214,4 million GT, 1,8% more than in January 2011 and a market share of 20,9% of the world fleet. Liberia, with 122,8 million GT (+3,9%) and 12,0% of the global GT, ranks second, followed by Marshall Islands 81,8 million GT (+12,5% and 8,0% of world GT). Both Hong Kong and Singapore registered fleet grew notably (+11,5% to 78,2 million GT and +12,6% to 58,9 million GT, respectively) occupying the fourth and fifth place in the world rank, respectively.

More than half of the GT registered in Panama corresponds to bulk carriers (30,9% of the world fleet of such vessels), 16,1% to container ships and 14,0% to oil tankers. In Liberia, 32,9% of the GT are container ships, 28,8% oil tankers and 27,6% bulk carriers. In the Marshall Islands, 38,8% of GT corresponds to bulk carriers and 31,7% to oil tankers and finally in Hong Kong, 55,3% of the registered GT are bulk carriers and containerships account for 19,6%.

Malta is the first European Union flag, occupying the seventh position in the world rank, with 43,9 million GT (-2,0%), followed by Greece with 41,1 million GT (-0,3%). The third EU flag (tenth in the world rank) is occupied by the UK, with 32,5 million GT (3,7%), followed by Cyprus with GT 19,5 million (-5,0%). EU (27) countries flag a total of 206,0 million GT (-2,5%), accounting for 20,1% of global GT. During 2012, apart from the UK, Poland (+1,3%), Luxembourg (+2,6%), Finland (+16,2%), Portugal (+18,2%) and Romania (+18,4%) recorded growth in their fleet. Meanwhile, Italy (-0,9%), Spain (-1,3%), the Netherlands (-2,1%) and to a greater extent, Belgium (-13,5%), Germany (-13,6%), Sweden (-15,7%) and France (-17,3%) flagged fleets decreased.

	1975	1980	1985	1990	1995	2000	2005	2010	2012	2013	GT change (%)	
											13/12	13/05
Panama	13,352	23,327	39,544	38,410	63,208	103,049	129,330	167,178	210,571	214,421	1.8	65.8
Liberia	65,633	80,167	57,979	54,231	57,172	52,932	52,527	90,162	118,167	122,754	3.9	133.7
Marshall Islands[1]	-	-	-	-	2,130	6,655	21,876	47,648	72,783	81,848	12.5	274.1
Hong Kong	411	1709	6842	6533	7,673	7,944	26,025	45,300	70,098	78,191	11.5	200.4
Singapore	3,853	7,520	6,398	7,815	11,720	21,500	25,814	39,665	43,536	58,942	12.6	128.3
Bahamas	179	78	3,864	13,464	22,628	26,952	33,707	45,017	46,816	46,024	-0.3	42.5
Malta	45	129	1,843	4,473	15,424	28,107	22,220	34,760	44,799	43,888	-2.0	97.5
Greece	22,451	39,377	30,898	20,384	30,061	24,756	31,971	38,776	41,206	41,073	-0.3	28.5
China	2,744	6,556	10,168	13,303	15,069	15,456	19,381	28,636	36,054	38,655	7.2	99.5
United Kingdom	32,231	26,108	13,942	7,778	5,867	8,306	18,238	27,590	31,386	32,550	3.7	78.5
Cyprus	3,217	2,079	8,179	18,304	23,224	23,344	21,147	19,842	20,493	19,470	-5.0	-7.9
Italy	9,931	9,696	8,587	7,462	6,371	7,750	10,653	15,210	18,100	17,931	-0.9	68.3
Japan	38,042	39,194	38,184	25,673	20,771	15,641	12,103	13,728	16,845	17,981	6.7	45.9
Norway	25,847	21,530	14,774	22,684	21,753	22,382	17,584	14,779	14,284	14,308	0.1	-18.6
Germany	9,592	9,384	7,176	5,324	5,454	6,329	8,046	14,931	15,064	13,006	-13.6	61.7
Denmark	4,354	5,211	4,767	4,900	5,818	5,567	7,311	10,863	11,369	11,295	-0.7	54.5
South Korea	1,388	4,281	6,664	7,213	6,420	5,119	7,228	12,238	11,419	11,108	-2.7	53.7
Antigua & Barbuda	-	-	1	359	1,837	4,214	7,164	9,947	11,081	10,582	-4.5	47.7
OTHER EU (over 200,000 GT)												
Netherlands	5,418	5,430	3,850	3,069	3,841	5,178	6,384	7,528	7,774	7,612	-2.1	19.2
France	10,389	11,557	7,888	3,525	4,069	3,067	4,615	6,371	6,583	5,445	-17.3	18.0
Belgium	1,249	1,697	2,251	1,769	65	8	3,829	4,105	4,194	3,627	-13.5	-5.3
Sweden	7,418	4,186	3,006	2,667	2692	1846	3,561	3,928	3,264	2,753	-15.6	-22.7
SPAIN	4,936	7,178	5,214	3,143	933	1,547	2,386	2,319	2,569	2,525	-1.3	6.0
Finland	1,966	2,472	1,916	1,000	1,319	1,566	1,334	1,364	1,461	1,721	16.2	29.0
Portugal	1,055	1,203	1,290	716	774	1,051	1,217	1,172	1,115	1,318	18.2	8.3
Luxembourg	-	-	-	2	1,135	1286	555	556	606	622	2.6	12.1
Lithuania	-	-	-	-	385	335	352	371	368	349	-5.2	-0.9
Estonia	-	-	-	-	485	391	304	344	292	281	-3.8	-7.6
Bulgaria	937	1,233	1,322	1,360	1,112	967	876	500	306	181	-40.8	-79.3
Total EU (15)	111,253	123,780	90,880	62,039	68,412	68,496	100,545	134,741	144,877	141,655	-2.2	28.8
Total EU (27)	118,795	132,328	108,214	93,479	115,009	123,915	146,174	191,131	211,383	206,079	-2.5	32.4
World totals	325,622	399,918	399,241	398,642	451,067	515,394	601,701	840,566	991,174	1,027,045	3.6	70.7
EU15/ World (%)	34.2%	31.0%	22.8%	15.6%	15.2%	13.3%	16.7%	16.0%	14.6%	13.8%		

Figures as of 31 July until 1990. As of 1 January since 1995.
[1] Until 1990 Marshall Islands were included in the USA
Figures in thousand GRT to 1990. Thousand GT from 1995.
Source: Lloyd's Register - Fairplay - World Fleet Statistics

Figure 101. World merchant fleet by country of registration (*source: Lloyd's Register*)

According to ISL Bremen, the fleet figures according to the nationality of the owner is, once again, led by Greece, with 260,4 million dwt (17,0% of the global shipping capacity) and a remarkable increase of 19,9% over the previous year, operating 72,4% of its fleet under foreign flags. Japan stood second, with 229,9 million dwt (+9,6%) and 92,7% of their tonnage under foreign flags. Third ranks China, with 160,9 million dwt (with a huge increase of +39.2%

according to data from ISL, although this increase may be due to some extent, to the reclassification of part of the Hong Kong carriers fleet) and 62,9% of their fleet under foreign flags. Germany descends from the third to the fourth place, with 131 million dwt (+4,4%) and 87,2% of its controlled tonnage under foreign flags. EU member countries (27) overall 589,1 million dwt, 38,4% of world tonnage. The Spanish carriers controlled fleet (according to data from LRF) loses 1 position and moves into 37th place, with 4,1 million dwt and a 1,4% increase.

1 JANUARY 2013	NATIONAL FLAG	FOREIGN FLAG	TOTAL
Greece	72	189	260
Japan	17	213	230
China	60	101	161
Germany	17	114	131
Korea	16	64	80
Norway	15	43	59
Singapore	22	26	48
USA	5	42	47
Taiwan	3	42	45
Denmark	13	30	42

Figure 102. Leading world merchant fleets by country of domicile (1 January 2013) (*source: ISL Bremen*)

In 2012, the extremely low freight levels in almost all markets and the credit constraints applied by banks resulted in very few orders for new ships. Specifically, after the decrease of 52,9% in new contracts in 2011, last year's contracting dropped again by almost 30%, totaling only 44,8 million dwt or 16 million CGT (-36%). This level of new orders, that, according to Platou is around 50% of the shipyards annual building capacity, reduced the average time of vessels delivery and therefore drove down new building prices. Platou estimates that in 2012 owners invested 30.000 million in new ships compared to 50.000 million last year.

Conversely, deliveries remained at very high levels, totaling 149,4 million dwt, only 8,7% less than the record reached in 2011. Of these deliveries, 65,8% (98,2 million dwt) were bulk carriers and 21,0% (31,4 million dwt) tankers. Also 1,3 million TEU of containerships were delivered.

As a result of the lower levels of orders and the high rate of deliveries, total order book fell by 34,4% and as of 1 January 2013, totaled 211,0 million dwt. Bulk carriers comprised half of the order book, with 105,4 million dwt (15,6% of the existing fleet of such vessels), followed by tankers, with 49,4 million dwt, accounting for 23,4% of the portfolio and 10,7% of the existing fleet. The containership order book included 3,4 million TEU (20% of the existing fleet) and that of LNG 92 ships, 27% of the existing fleet capacity.

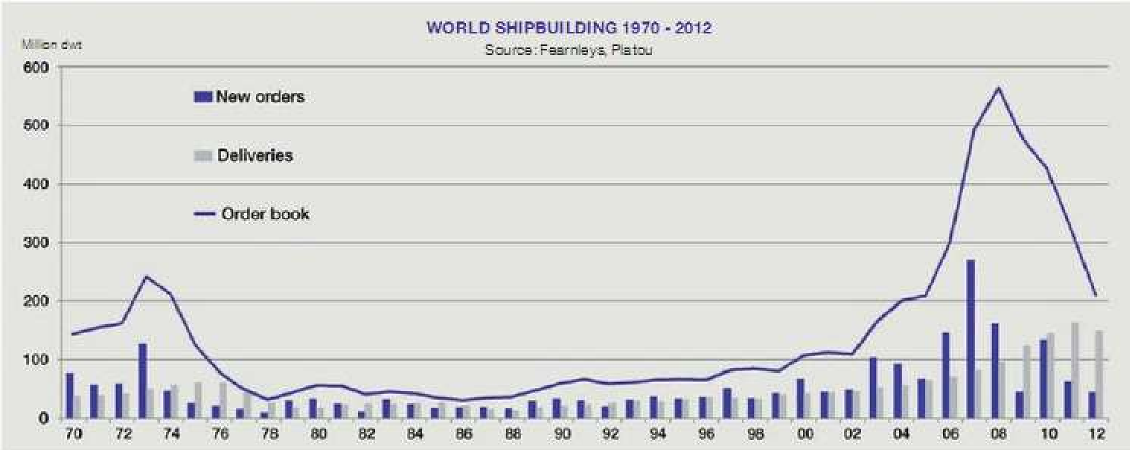


Figure 103. World shipbuilding (1970-2012) (*source: Fearnieys Platou*)

Last year, 81,2% of new orders were for shipyards in China, South Korea and Japan. China obtained a 34,6%, slightly lower than in 2011 (-0,8%) and, according to Platou, one third of the CGT were contracted to Chinese owners. In Korea, the new contracts fell by 48,5% and accounted for 28,8% of total CGT ordered. Japan obtained 17,8% of the contracted CGT, with an increase of 7,1%. The shipyards in the EU-27 achieved 6,3% of new contracts in CGT, a figure similar to that of 2011 (+0,2%). Spanish shipyards got 0,4% of new contracts in CGT (about 108.000 CGT) in 2 ferries and 25 vessels for various uses (tugs, off-shore supply, platform supply, live fish transportation, fisheries and oceanographic research).

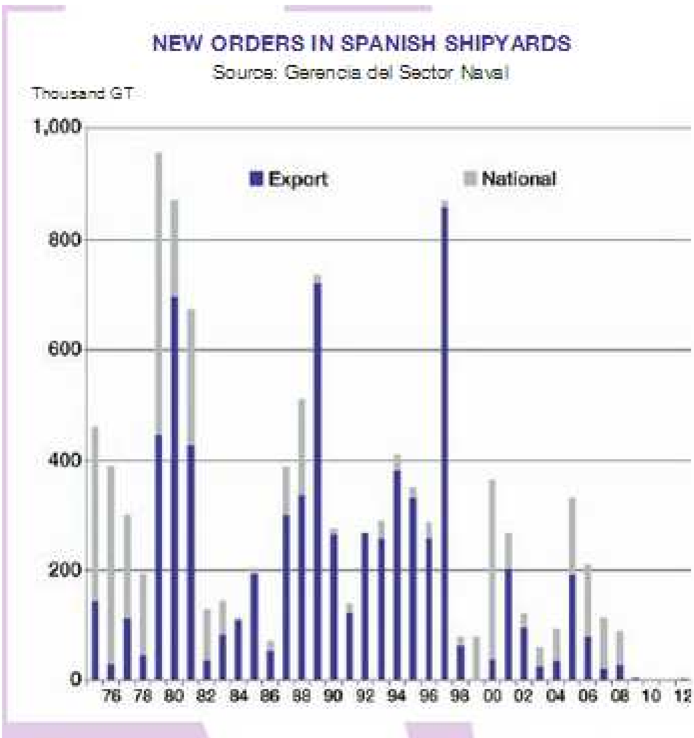


Figure 104. New orders in Spanish shipyards (1976-2012) (*source: Gerencia del Sector Naval, Spain*)

Prices of new constructions fell between 5 and 10%, depending on the ship type, size and shipyard country. The weakness of demand, lack of funding, the decline in prices in the second hand market and shipyards overcapacity have been some of the factors that have led to this situation, but also influenced the decline in steel prices.

3.2. Maritime services from mainland China to the European Mediterranean ports

In order to execute the interviews to the main carriers operating between mainland China and the European Mediterranean ports, first a research about the maritime services currently existing between mainland China and the Mediterranean Ports selected was done.

All the Far-East Container Services currently available from the Mediterranean European Ports are displayed in the following tables. For each of them, the name of the service, the name of the carriers operating on it, the duration of the whole rotation, the frequency, the number of ships operating on it and their capacity, the average amount of weekly TEU transported, the average dwt and average speed of the vessels operating on it and the exact rotation of the service is shown.

Table 164. Current maritime services of TEU from mainland China to Port of Barcelona (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Barcelona	Maersk Line / CMA CGM - AE-11 / MEX 1	Maersk / CMA CGM / slots: ANL	77	Weekly	11 x 9.500 / 13.000 TEU	12.602	138.079	24	Marsaxlokk, Valencia, **Barcelona**, Fos, Marsaxlokk, Port Said (SCCT), Salalah, Khor Fakkan, Port Kelang, Singapore, **Qingdao**, Busan, **Shanghai**, **Ningbo**, **Nansha** (skipped Mar-May), **Yantian**, **Chiwan**, Tanjung Pelepas, Port Kelang (skipped Mar-May), Marsaxlokk
Barcelona	G6 - Asia-Europe Loop 8 (EU M)	Hapag-Lloyd / NYK / OOCL / APL / MOL / HMM	70	Weekly	10 x 8.000 / 9.000 TEU	8.417	100.749	25	Port Said (SCCT), Genoa, Fos, **Barcelona**, Valencia, Port Said (SCCT), Jeddah, Singapore, Hong Kong, Busan, **Shanghai**, **Ningbo**, **Shekou**, Hong Kong, Singapore, Jeddah, Port Said (SCCT)
Barcelona	CKYH / Evergreen - Asia-Med Loop 1 - MD 1 (CSCL : AMX 4)	COSCO / Hanjin / K Line / Yang Ming / slots: CSCL / Evergreen	70	Weekly	10 x 8.000 / 10.000 TEU	7.724	101.014	25	Piraeus, La Spezia, Genoa, **Barcelona**, Valencia, Piraeus, Singapore, Hong Kong, **Qingdao**, **Shanghai**, **Ningbo**, **Yantian**, Hong Kong, **Nansha**, Singapore, Piraeus
Barcelona	CKYH / Evergreen - Asia-Med Loop 2 - MD 2 (CSCL : AMX 3)	K Line / Yang Ming / slots: COSCO / Hanjin / Evergreen / CSCL	70	Weekly	10 x 8.000 / 9.000 TEU (2 sailings skipped)	6.934	100.853	24	Port Said, Ashdod, Genoa, **Barcelona**, Fos, Port Said, Singapore, Hong Kong, **Xiamen**, **Ningbo**, **Shanghai**, Kaohsiung, **Yantian**, Singapore, Port Said
Barcelona	UASC / CSCL - Asia-Med service (AMC-1 / AMX 1) (YM : AM 1)	UASC / CSCL / slots: COSCO / Yang Ming / Hanjin / Evergreen	70	Weekly	10 x 6.900 / 8.500 TEU	7.105	87.106	25	Port Said, La Spezia, Genoa, Fos, **Barcelona**, Valencia, Port Said, Jeddah, Khor Fakkan, Port Kelang, **Qingdao**, **Shanghai**, **Ningbo**, **Shekou**, Port Kelang, Port Said
Barcelona	MSC - Asia-Med service (Dragon Service)	MSC	84	Weekly	12 x 13.000 / 14.000 TEU	13.890	160.301	24	Gioia Tauro, Valencia, La Spezia, Fos, **Barcelona**, Gioia Tauro, Jeddah, Salalah, Jebel Ali, Singapore, **Chiwan**, Hong Kong, **Dalian**, **Xingang**, Busan, **Qingdao**, **Ningbo**, **Shanghai**, **Yantian**, Hong Kong, **Chiwan**, Singapore, Gioia Tauro

Table 165. Current maritime services of TEU from mainland China to Port of Valencia (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Valencia	Maersk Line / CMA CGM - AE-11 / MEX 1	Maersk / CMA CGM / slots: ANL	77	Weekly	11 x 9.500 / 13.000 TEU	12.602	138.079	24	Marsaxlokk, **Valencia**, Barcelona, Fos, Marsaxlokk, Port Said (SCCT), Salalah, Khor Fakkan, Port Kelang, Singapore, **Qingdao**, Busan, **Shanghai**, **Ningbo**, **Nansha** (skipped Mar-May), **Yantian**, **Chiwan**, Tanjung Pelepas, Port Kelang (skipped Mar-May), Marsaxlokk
Valencia	G6 - Asia-Europe Loop 8 (EU M)	Hapag-Lloyd / NYK / OOCL / APL / MOL / HMM	70	Weekly	10 x 8.000 / 9.000 TEU	8.417	100.749	25	Port Said (SCCT), Genoa, Fos, Barcelona, **Valencia**, Port Said (SCCT), Jeddah, Singapore, Hong Kong, Busan, **Shanghai**, **Ningbo**, **Shekou**, Hong Kong, Singapore, Jeddah, Port Said (SCCT)
Valencia	CKYH / Evergreen - Asia-Med Loop 1 - MD 1 (CSCL : AMX 4)	COSCO / Hanjin / K Line / Yang Ming / slots: CSCL / Evergreen	70	Weekly	10 x 8.000 / 10.000 TEU	7.724	101.014	25	Piraeus, La Spezia, Genoa, Barcelona, **Valencia**, Piraeus, Singapore, Hong Kong, **Qingdao**, **Shanghai**, **Ningbo**, **Yantian**, Hong Kong, **Nansha**, Singapore, Piraeus
Valencia	UASC / CSCL - Asia-Med service (AMC-1 / AMX 1) (YM : AM 1)	UASC / CSCL / slots: COSCO / Yang Ming / Hanjin / Evergreen	70	Weekly	10 x 6.900 / 8.500 TEU	7.105	87.106	25	Port Said, La Spezia, Genoa, Fos, Barcelona, **Valencia**, Port Said, Jeddah, Khor Fakkan, Port Kelang, **Qingdao**, **Shanghai**, **Ningbo**, **Shekou**, Port Kelang, Port Said
Valencia	MSC - Asia-Med service (Dragon Service)	MSC	84	Weekly	12 x 13.000 / 14.000 TEU	13.890	160.301	24	Gioia Tauro, **Valencia**, La Spezia, Fos, Barcelona, Gioia Tauro, Jeddah, Salalah, Jebel Ali, Singapore, **Chiwan**, Hong Kong, **Dalian**, **Xingang**, Busan, **Qingdao**, **Ningbo**, **Shanghai**, **Yantian**, Hong Kong, **Chiwan**, Singapore, Gioia Tauro
Valencia	Maersk Line - New AE-6 / TP-6 pendulum	Maersk	112	Weekly	16 x 9.500 / 9.700 TEU (2 sailings skipped)	8.406	114.814	24	Bremerhaven, Hamburg, Felixstowe, Le Havre, Tangier, Valencia, Salalah, Singapore, Cai Mep (~Ho Chi Minh City), **Nansha**, **Yantian**, Hong Kong, Los Angeles, Vostochny (bunkering), **Ningbo**, **Shanghai**, **Xiamen**, **Yantian**, Tanjung Pelepas, Algeciras, Bremerhaven

Table 166. Current maritime services of TEU from mainland China to Port of Algeciras (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Algeciras	Maersk Line - New AE-6 / TP-6 pendulum	Maersk	112	Weekly	16 x 9.500 / 9.700 TEU (2 sailings skipped)	8.406	114.814	24	Bremerhaven, Hamburg, Felixstowe, Le Havre, Tangier, Valencia, Salalah, Singapore, Cai Mep (~Ho Chi Minh City), **Nansha**, **Yantian**, Hong Kong, Los Angeles, Vostochny (bunkering), **Ningbo**, **Shanghai**, **Xiamen**, **Yantian**, Tanjung Pelepas, **Algeciras**, Bremerhaven
Algeciras	G6 / Evergreen - Asia-USEC service (SVS / AUE 3) - Suez route	Hapag-Lloyd / NYK / OOCL / APL / MOL / HMM / Evergreen	70	Weekly	10 x 6.500 TEU	6.539	75.776	25	Hong Kong, **Yantian**, Singapore ...(Suez)... **Algeciras** (TTI), Norfolk, Savannah, Jacksonville, Charleston, **Algeciras** (TTI) ...(Suez)... Colombo, Singapore, Cai Mep (~Ho Chi Minh City), Hong Kong
Algeciras	Maersk Line / CMA CGM - AE-20 / MEX 3	Maersk / CMA CGM / slots: ANL	70	Weekly	10 x 8.500 / 9.500 TEU	9.029	110.083	25	**Algeciras**, Tangier, Marsaxlokk, Port Said (SCCT), Port Kelang, Singapore, **Xiamen**, **Shanghai**, **Ningbo**, **Yantian**, **Nansha**, Tanjung Pelepas, Port Kelang, Jeddah, Port Said, Marsaxlokk, Genoa, La Spezia, **Algeciras**
Algeciras	CKYH / Evergreen - Asia-North Europe Loop 6 - NE 6 (UASC : AEC 9) (CSCL : AEX 5)	Hanjin / K Line / Yang Ming / COSCO / slots: UASC / CSCL / Evergreen	77	Weekly	11 x 8.500 / 13.000 TEU	12.558	135.926	24	Hamburg, Rotterdam, Le Havre, **Algeciras** (TTI), Singapore, **Yantian**, **Qingdao**, Kwangyang, Busan, **Shanghai**, **Yantian**, Singapore, **Algeciras** (TTI), Hamburg

Table 167. Current maritime services of TEU from mainland China to Port of Tanger MED (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Tanger MED	Maersk Line - New AE-6 / TP-6 pendulum	Maersk	112	Weekly	16 x 9.500 / 9.700 TEU (2 sailings skipped)	8.406	114.814	24	Bremerhaven, Hamburg, Felixstowe, Le Havre, **Tangier**, Valencia, Salalah, Singapore, Cai Mep (~Ho Chi Minh City), **Nansha**, **Yantian**, Hong Kong, Los Angeles, Vostochny (bunkering), **Ningbo**, **Shanghai**, **Xiamen**, **Yantian**, Tanjung Pelepas, Algeciras, Bremerhaven
Tanger MED	Maersk Line - TP-7 - FE-USEC service via Suez	Maersk	84	Weekly	12 x 5.400 / 8.400 TEU	7.150	-	-	**Ningbo**, **Shanghai**, **Yantian**, Hong Kong, Tanjung Pelepas ...(Suez)... **Tangier**, Savannah, Charleston, Miami, **Tangier** ...(Suez)... Jeddah, Kaohsiung, **Ningbo**
Tanger MED	Maersk Line - AE-10	Maersk	84	Weekly	12 x 15.500 / 18.200 TEU	17.136	-	-	Rotterdam, Bremerhaven, Gdansk, Aarhus, Goteborg, Bremerhaven, Rotterdam, Le Havre (occasional), **Tangier**, Tanjung Pelepas, **Yantian**, Hong Kong, Busan, Kwangyang, **Ningbo**, **Shanghai**, **Yantian**, Tanjung Pelepas, Rotterdam
Tanger MED	Maersk Line / CMA CGM - AE-20 / MEX 3	Maersk / CMA CGM / slots: ANL	70	Weekly	10 x 8.500 / 9.500 TEU	9.029	110.083	25	Algeciras, **Tangier**, Marsaxlokk, Port Said (SCCT), Port Kelang, Singapore, **Xiamen**, **Shanghai**, **Ningbo**, **Yantian**, **Nansha**, Tanjung Pelepas, Port Kelang, Jeddah, Port Said, Marsaxlokk, Genoa, La Spezia, Algeciras
Tanger MED	MSC / CMA CGM - Asia-Europe service (Condor / FAL 1)	CMA CGM / slots: MSC / ANL / for Baltic: FESCO	77	Weekly	11 x 13.000 / 16.000 TEU	12.764	-	-	Southampton, Hamburg, Bremerhaven, Rotterdam, Zeebrugge, Le Havre, Marsaxlokk, Khor Fakkan, Jebel Ali, Port Kelang, **Ningbo**, **Shanghai**, **Xiamen**, Hong Kong, **Chiwan**, **Yantian**, Port Kelang, **Tangier**, Southampton

Table 168. Current maritime services of TEU from mainland China to Port of Malta (Marsaxlokk + Valletta) (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Marsaxlokk	Maersk Line / CMA CGM - AE-11 / MEX 1	Maersk / CMA CGM / slots: ANL	77	Weekly	11 x 9.500 / 13.000 TEU	12.602	138.079	24	**Marsaxlokk**, Valencia, Barcelona, Fos, Marsaxlokk, Port Said (SCCT), Salalah, Khor Fakkan, Port Kelang, Singapore, **Qingdao**, Busan, **Shanghai**, **Ningbo**, **Nansha** (skipped Mar-May), **Yantian**, **Chiwan**, Tanjung Pelepas, Port Kelang (skipped Mar-May), **Marsaxlokk**
Marsaxlokk	Maersk Line / CMA CGM - AE-20 / MEX 3	Maersk / CMA CGM / slots: ANL	70	Weekly	10 x 8.500 / 9.500 TEU	9.029	110.083	25	Algeciras, Tangier, **Marsaxlokk**, Port Said (SCCT), Port Kelang, Singapore, **Xiamen**, **Shanghai**, **Ningbo**, **Yantian**, **Nansha**, Tanjung Pelepas, Port Kelang, Jeddah, Port Said, **Marsaxlokk**, Genoa, La Spezia, Algeciras
Marsaxlokk	MSC / CMA CGM - Asia-Europe service (Condor / FAL 1)	CMA CGM / slots: MSC / ANL / for Baltic: FESCO	77	Weekly	11 x 13.000 / 16.000 TEU	12.764	-	-	Southampton, Hamburg, Bremerhaven, Rotterdam, Zeebrugge, Le Havre, **Marsaxlokk**, Khor Fakkan, Jebel Ali, Port Kelang, **Ningbo**, **Shanghai**, **Xiamen**, Hong Kong, **Chiwan**, **Yantian**, Port Kelang, Tangier, Southampton

Table 169. Current maritime services of TEU from mainland China to Port of Gioia Tauro (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Gioia Tauro	MSC / CMA CGM - Asia-North Europe service (Silk / FAL 6)	MSC / slots: CMA CGM / on Eur-ME: CSAV	84	Weekly	12 x 12.500 / 14.000 TEU	13.448	-	-	Felixstowe, Zeebrugge, Antwerp, Rotterdam, **Gioia Tauro**, Jebel Ali, Singapore, Hong Kong, **Xingang**, Kwangyang, Busan, **Qingdao**, **Ningbo**, **Shanghai**, Singapore, Port Kelang, Felixstowe
Gioia Tauro	MSC - Asia-Med service (Dragon Service)	MSC	84	Weekly	12 x 13.000 / 14.000 TEU	13.890	160.301	24	**Gioia Tauro**, Valencia, La Spezia, Fos, Barcelona, **Gioia Tauro**, Jeddah, Salalah, Jebel Ali, Singapore, **Chiwan**, Hong Kong, **Dalian**, **Xingang**, Busan, **Qingdao**, **Ningbo**, **Shanghai**, **Yantian**, Hong Kong, **Chiwan**, Singapore, **Gioia Tauro**

Table 170. Current maritime services of TEU from mainland China to Port of La Spezia (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
La Spezia	Maersk Line / CMA CGM - AE-20 / MEX 3	Maersk / CMA CGM / slots: ANL	70	Weekly	10 x 8.500 / 9.500 TEU	9.029	110.083	25	Algeciras, Tangier, Marsaxlokk, Port Said (SCCT), Port Kelang, Singapore, **Xiamen**, **Shanghai**, **Ningbo**, **Yantian**, **Nansha**, Tanjung Pelepas, Port Kelang, Jeddah, Port Said, Marsaxlokk, Genoa, **La Spezia**, Algeciras
La Spezia	UASC / CSCL - Asia-Med service (AMC-1 / AMX 1) (YM : AM 1)	UASC / CSCL / slots: COSCO / Yang Ming / Hanjin / Evergreen	70	Weekly	10 x 6.900 / 8.500 TEU	7.105	87.106	25	Port Said, **La Spezia**, Genoa, Fos, Barcelona, Valencia, Port Said, Jeddah, Khor Fakkan, Port Kelang, **Qingdao**, **Shanghai**, **Ningbo**, **Shekou**, Port Kelang, Port Said
La Spezia	MSC - Asia-Med service (Dragon Service)	MSC	84	Weekly	12 x 13.000 / 14.000 TEU	13.890	160.301	24	Gioia Tauro, Valencia, **La Spezia**, Fos, Barcelona, Gioia Tauro, Jeddah, Salalah, Jebel Ali, Singapore, **Chiwan**, Hong Kong, **Dalian**, **Xingang**, Busan, **Qingdao**, **Ningbo**, **Shanghai**, **Yantian**, Hong Kong, **Chiwan**, Singapore, Gioia Tauro

Table 171. Current maritime services of TEU from mainland China to Port of Genova (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Genova	Maersk Line / CMA CGM - AE-20 / MEX 3	Maersk / CMA CGM / slots: ANL	70	Weekly	10 x 8.500 / 9.500 TEU	9.029	110.083	25	Algeciras, Tangier, Marsaxlokk, Port Said (SCCT), Port Kelang, Singapore, **Xiamen**, **Shanghai**, **Ningbo**, **Yantian**, **Nansha**, Tanjung Pelepas, Port Kelang, Jeddah, Port Said, Marsaxlokk, **Genoa**, La Spezia, Algeciras
Genova	G6 - Asia-Europe Loop 8 (EU M)	Hapag-Lloyd / NYK / OOCL / APL / MOL / HMM	70	Weekly	10 x 8.000 / 9.000 TEU	8.417	100.749	25	Port Said (SCCT), **Genoa**, Fos, Barcelona, Valencia, Port Said (SCCT), Jeddah, Singapore, Hong Kong, Busan, **Shanghai**, **Ningbo**, **Shekou**, Hong Kong, Singapore, Jeddah, Port Said (SCCT)
Genova	CKYH / Evergreen - Asia-Med Loop 2 - MD 2 (CSCL : AMX 3)	K Line / Yang Ming / slots: COSCO / Hanjin / Evergreen / CSCL	70	Weekly	10 x 8.000 / 9.000 TEU (2 sailings skipped)	6.934	100.853	24	Port Said, Ashdod, **Genoa**, Barcelona, Fos, Port Said, Singapore, Hong Kong, **Xiamen**, **Ningbo**, **Shanghai**, Kaohsiung, **Yantian**, Singapore, Port Said
Genova	UASC / CSCL - Asia-Med service (AMC-1 / AMX 1) (YM : AM 1)	UASC / CSCL / slots: COSCO / Yang Ming / Hanjin / Evergreen	70	Weekly	10 x 6.900 / 8.500 TEU	7.105	87.106	25	Port Said, La Spezia, **Genoa**, Fos, Barcelona, Valencia, Port Said, Jeddah, Khor Fakkan, Port Kelang, **Qingdao**, **Shanghai**, **Ningbo**, **Shekou**, Port Kelang, Port Said

Table 172. Current maritime services of TEU from mainland China to Port of Marseille (*source: own-source*)

Port	Service	Carriers	Duration (days)	Frequency	Ships	TEU weekly	Average dwt (tonnes)	Average speed (km/h)	Rotation
Fos	Maersk Line / CMA CGM - AE-11 / MEX 1	Maersk / CMA CGM / slots: ANL	77	Weekly	11 x 9.500 / 13.000 TEU	12.602	138.079	24	Marsaxlokk, Valencia, Barcelona, **Fos**, Marsaxlokk, Port Said (SCCT), Salalah, Khor Fakkan, Port Kelang, Singapore, **Qingdao**, Busan, **Shanghai**, **Ningbo**, **Nansha** (skipped Mar-May), **Yantian**, **Chiwan**, Tanjung Pelepas, Port Kelang (skipped Mar-May), Marsaxlokk
Fos	G6 - Asia-Europe Loop 8 (EU M)	Hapag-Lloyd / NYK / OOCL / APL / MOL / HMM	70	Weekly	10 x 8.000 / 9.000 TEU	8.417	100.749	25	Port Said (SCCT), Genoa, **Fos**, Barcelona, Valencia, Port Said (SCCT), Jeddah, Singapore, Hong Kong, Busan, **Shanghai**, **Ningbo**, **Shekou**, Hong Kong, Singapore, Jeddah, Port Said (SCCT)
Fos	CKYH / Evergreen - Asia-Med Loop 2 - MD 2 (CSCL : AMX 3)	K Line / Yang Ming / slots: COSCO / Hanjin / Evergreen / CSCL	70	Weekly	10 x 8.000 / 9.000 TEU (2 sailings skipped)	6.934	100.853	24	Port Said, Ashdod, Genoa, Barcelona, **Fos**, Port Said, Singapore, Hong Kong, **Xiamen**, **Ningbo**, **Shanghai**, Kaohsiung, **Yantian**, Singapore, Port Said
Fos	UASC / CSCL - Asia-Med service (AMC-1 / AMX 1) (YM : AM 1)	UASC / CSCL / slots: COSCO / Yang Ming / Hanjin / Evergreen	70	Weekly	10 x 6.900 / 8.500 TEU	7.105	87.106	25	Port Said, La Spezia, Genoa, **Fos**, Barcelona, Valencia, Port Said, Jeddah, Khor Fakkan, Port Kelang, **Qingdao**, **Shanghai**, **Ningbo**, **Shekou**, Port Kelang, Port Said
Fos	MSC - Asia-Med service (Dragon Service)	MSC	84	Weekly	12 x 13.000 / 14.000 TEU	13.890	160.301	24	Gioia Tauro, Valencia, La Spezia, **Fos**, Barcelona, Gioia Tauro, Jeddah, Salalah, Jebel Ali, Singapore, **Chiwan**, Hong Kong, **Dalian**, **Xingang**, Busan, **Qingdao**, **Ningbo**, **Shanghai**, **Yantian**, Hong Kong, **Chiwan**, Singapore, Gioia Tauro

As it can be observed, there are some carriers that do not operate vessels in some services. This means that they just book slots in others carriers' vessels of the same route in order to offer their services. This is what in the column "Carriers" is called "slots". For each maritime service, the carriers providing vessels are marked in blue colour, while the ones using slots in other carriers' vessels are marked in red colour. The three carriers that do not provide vessels in any maritime service – they just use slots in other carriers' vessels – are ANL, FESCO and CSAV.

Concerning the rotation, for each maritime service the Mediterranean port under consideration and the Chinese Ports of the rotation (only the ones in mainland China) are marked in black colour. It can be observed that there are four Mediterranean Ports – Barcelona, Valencia, La Spezia, Marseille-Fos – that currently are connected to ten Chinese Ports – Chiwan, Dalian, Nansha, Ningbo, Qingdao, Shanghai, Shekou, Xiamen, Xingang, Yantian –. Following these, there are three other Mediterranean Ports – Genova, Gioia Tauro, Marsaxlokk – currently connected to seven Chinese Ports (in the three cases included in the list of ten Chinese Ports just mentioned). Finally, there are two Mediterranean Ports – Tanger MED and Algeciras – currently connected to six Chinese Ports (in both cases also included in the list of ten Chinese Ports just mentioned).

All the maritime services in the tables above arrive in Europe via Suez on large, dedicated container vessels. To maximise the benefits of scale, the number of port calls are relatively low and concentrated at the beginning and end of the rotation. The duration of each maritime service depends on the rotation (number of calls) and the average speed. It can be seen how the duration ranges between 70 days and 112 days, mostly comprised between 70 days and 84 days.

In addition, the number of ships of each route depends on the duration and the frequency. For example, if the duration is 77 days and the frequency is weekly, 11 vessels are required to cover that maritime service. Currently all the services provided between mainland China and the Mediterranean Ports selected have weekly frequency.

The capacity of the vessels operating these routes ranges between 7.000 TEU and 14.000 TEU, although there are two services with capacity <6.500 TEU – to Algeciras and Tanger MED – and there are two services with capacity >14.000 TEU – to Marsaxlokk and Tanger MED –. It must be noted that currently the highest capacity of a vessel in a maritime service between mainland China and Europe is 16.000 TEU. Obviously, the average dwt of each maritime service depends on its capacity and also on the rate of empty containers transported.

The average weekly TEU transported by each maritime service is a measure of how full is the vessel in each operating route. In some cases the weekly TEU transported in a service almost coincides with the capacity of the service (for example, in the MSC – Asia-Med service (Dragon service), where the capacity is 14.000 TEU and the average number of TEU weekly transported is 13.980). In some other cases the average number of TEU weekly transported in a service is much lower than its capacity (for example, in the CKYH / Evergreen - Asia-Med Loop 2 - MD 2 (CSCL : AMX 3), where the capacity is 9.000 TEU and the average number of TEU weekly transported is 6.934). However, the number of TEU transported by each maritime service does not mean that the containers transported have as their final destination the Mediterranean Port under consideration. The origin and destination of the containers can be any port in the whole rotation. That is why if we add together the number of TEU weekly transported of all the maritime services affecting each port, the ranking of Ports does not coincide with the one done before about exports and imports from the ports.

In conclusion, from these tables the carriers to interview where identified, and are the following: Maersk Line, CMA CGM, ANL, Hapag-Lloyd, NYK Lines, Orient Overseas Container Line (OOCL), American President Line (APL), Mitsui Osk Lines (MOL), Hyundai Merchant Marine (HMM), COSCO Container Lines, Hanjin Shipping Co., K Line, Yang Ming Line, China Shipping Container Lines (CSCL), Evergreen Marine, United Arab Shipping Co. (UASC), Mediterranean Shipping Co. (MSC) and Compañía Sud Americana de Vapores (CSAV).

3.3. Interview conclusions

8 out of the 18 carriers identified offering maritime services from mainland China to Europe were interviewed. The other 10 carriers did not want to answer the interview adducing to confidential and company's policy reasons. The contacts for executing the interviews were extracted from CEIBS, Port of Barcelona, Shanghai Maritime University and personal contacts. It was not easy to arrange meetings with these carriers, but the maximum possible information given by all of them is summarised here and in Annex nº3.

Some of the carriers interviewed provided specific figures about their business; others only orientation qualitative data. In any case, in the following paragraphs the main conclusions about the interviews are summarised.

Among the maritime services from mainland China to the Mediterranean Europe, only direct calls at a few ports are done by each carrier. These direct calls differ from one carrier to another. For example, MSC has direct calls at Barcelona, Genova, Gioia Tauro, Marseille Fos, La Spezia and Valencia; CSCL at Barcelona, Genova, Marseille Fos and Valencia; APL at Barcelona, Marseille Fos, Valencia and Genova; NYK at Barcelona, Genova, Marseille Fos and Valencia (same as APL because they work together in the same alliance: G6); CMA CGM at Malta and other ports such as Barcelona, Genova and Marseille Fos; COSCO at Piraeus, Genova, Barcelona, Valencia, Algeciras, Marseille Fos.

The main reason for using these ports in each case is either the gateway role of the port or its hub role. For example, APL uses Barcelona, Marseille Fos, Valencia and Genova as gateway ports to serve the South European markets: France, Italy and Spain. On the other hand, Malta is CMA CGM's hub port in Europe: all the maritime services offered by the company stop in Malta, in part thanks to the leverage that they have in this port. Feeder services from Malta are in charge of transhipping the cargo from Malta to its destination.

Although this study is focused on the European Mediterranean ports, it was stated by the carriers that they export much more containers from mainland China to Northern Europe than to Southern Europe. For example, in 2013 COSCO shipped approximately 1,7 million TEU from mainland China to Europe; the number of containers sent weekly from mainland China to North Europe (13.000 TEU) was the double than the number of containers sent weekly from mainland China to the Mediterranean Europe (6.500 TEU).

In most of the cases, carriers work together in order to optimise their vessels and get higher load factors. That is why some carriers use slots in other carriers' vessels, so they both win. For example, from the Port of Shanghai MSC operates 4 vessels: 2 of them self-owned and two others shared with CMA CGM; CSCL uses slots in other carriers in order to reach the European ports where it does not call directly; CSAV signed a slot charter agreement with MSC; etc. That is why alliances are very important in the currently existing maritime services from mainland China to Europe; COSCO being a great example of that: the current maritime services offered by COSCO to the Mediterranean Europe are: MED1 (together with Hanjin), MED2 (together with K Line and Yang Ming Line), slots in an Evergreen service and slots in a CSCL service.

All the maritime services offered by the carriers interviewed have a significant rate of transhipment, that is lower or higher as a function of the operating ports of each carrier. For example, in the case of MSC, approximately 50% of the containers loaded in Shanghai (2.500-3.000) that go to Europe are transhipped in the European Port. This percentage is similar for Ningbo (2.500-3.000 TEU transhipped in Europe), 25% for Xingang and Qingdao (1.250-1.500 TEU transhipped in Europe) and around 15% for Dalian (400-500 TEU transhipped in Europe).

Another example of a carrier with a significant rate of transhipment in Europe is CSAV. Out of the 46.000 TEU shipped yearly by them from mainland China to Ambarli, 22.500 TEU are after transhipped by a feeder service. The main destinations of these transhipments are: Novorossiysk (Russia), Poti (Georgia) and other ports in Turkey. On the other hand, none of the 3.000 TEU shipped yearly by them from mainland China to Piraeus is after transhipped.

Most of the carriers do not have their own feeder services in the European Mediterranean ports. Nevertheless, some do. For example, MSC: their own feeder services capacity is 1.000-2.000

TEU, the bigger ones at most 3.000-4.000 TEU. The frequency of these feeder services is at least two times a week, while the truck service frequency is daily. One of the main destinations of the MSC feeder services is North Europe, especially England. Therefore, it is common that a mother vessel of 10.000 TEU capacity unloads half of the cargo in Barcelona, and the second half is sent by a feeder service to England, where after it is sent by truck to a container yard where the client picks it up.

Also COSCO has its own feeder services, but not so many. Currently, COSCO has its own feeder services from Piraeus to Turkey and to the Black Sea. From Barcelona and Valencia COSCO uses the common feeder services. They state that in the future they will invest in their own feeder services from the Mediterranean Ports.

On the other hand, China Shipping Container Lines does not have its own feeder services in the European Mediterranean ports. Their procedure is the following: they have presence in 4 ports in Europe, while COSCO has presence in 6. Therefore, they decide to work together and use slots in each other's vessels and there is no need of feeder services.

Another example of carrier without its own feeder services in the Mediterranean Europe is APL. They prefer to use the inland modes of transport, especially trucking, in order to serve the hinterland. This justifies why they do not use ports as Malta or Gioia Tauro, that are basically transhipment ports but they do not have a strong hinterland to serve.

Finally, both CMA CGM and NYK do not have their own feeder services in the Mediterranean Europe: they use common public feeders.

In Barcelona, 92% of transits are fed up by dedicated feeder networks – for example, this is the case of MSC, CMA-CGM or Maersk –, and only an 8% of transits are covered through public feeders, all of them operated by X-Press Container Line.

About the future, according to the carriers' point of view, no big changes are expected in the current feeder networks in the Mediterranean Europe. For example, MSC does not plan to apply any change in terms of feeder services offered from the Mediterranean Europe market, as the relation is currently stable. MSC will keep exporting a lot of cargo from mainland China to England by feeder services from a Mediterranean European Port, as they have been doing until now. However, for MSC the limitation of 2.000 TEU capacity of the current feeder vessels may be increased to 4.000 TEU in the near future.

Other carriers such as CSCL, NYK and CSAV stated that no plans of changes are expected for the Mediterranean Europe. The reason of that is that there is not a big enough consumption market in the South of Europe. If someday the situation changes and the Southern Europe economy is as big as the Northern Europe, then CSCL will change all its routes and redirect them to the South, but nowadays there is no Southern country able to compete with the Northern ones.

Only CMA CGM stated that in the near future plans to increase its current 5 maritime services from Asia to North Europe to 8 and its current 3 maritime services from Asia to the Mediterranean Europe to 5. This means that the company plans to increase its offer both in Northern and Southern Europe.

On the other hand, with other parts of the World, especially with Africa, there will be a lot of changes in the shipping industry. In 2013 Xi Jinping, China’s former president, went to Africa and gave a lot of money to the local people with the only condition that they must buy products made in China. This means that the number of shipping services between mainland China and Africa will increase a lot in the next years. MSC, for example, will introduce in June 2014 a new service called Africa Express, which will go directly from the main Chinese ports to the main African Ports.

When talking about door-to-door services, after the interviews seems that carriers do not plan to offer new services of this type. Actually, all depends on economics: if there is a region in the Mediterranean that is developing faster, then carriers will use it as its entry to Europe. When suggested about the East of Europe market, which is growing very fast in the recent years, carriers stated that the Eastern Europe is served from Hamburg rather than from the Mediterranean Sea.

Only CMA CGM stated that they have a very strong door-to-door service, because they have relations with all the logistics companies operating in the main European ports. In the future they specially have interest in increasing these door-to-door services, but they also plan to increase the hub and spoke services and the transits to transoceanic routes.

Concerning the decision variables when selecting a transhipment port in Europe, all the carriers interviewed suggest that everything is simplified to an optimization problem, where the objective is to reduce the cost. What all the carriers first do is determine where the demand is, and then calculate which is the transhipment port that will cause fewer costs for using it. In that sense, the leverage in a terminal of a Port is very important for most of the carriers, as they can save a lot of money for using it. Although the differences between European ports are not very big, the optimization problem is still solved with all the variables in order to select the cheapest and reasonable port of destination in Europe.

In that sense, most of the services offered by the carriers interviewed are in Northern Europe, because the fixed costs there are lower. For example, the main transhipment port for NYK in Europe is Hamburg, where the costs are much lower and the feeder service options are wider.

Regardless the monetary costs, the technical condition of the terminal, the transit policies of the port (customs declaration, inspections, etc.) and the degree of saturation (rate of usage) of it are very important factors when selecting a transhipment port in Europe.

Moreover, the services and facilities in the terminal and the proximity to the hinterland destination are also quite important. At this point, it must be said that most of the carriers interviewed think that all the terminals in Europe are very efficient compared to other non-developed countries, confirming also that Northern European ports are more efficient than the Southern ones.

Finally, the alliance, the sea distance from the origin port, the communication/language/customer service and all the e-commerce services are the less important decision criteria when choosing a transhipment port in Europe. Concerning all the e-commerce services, it was found out that the policy of most carriers consists in sharing only the basic information in Internet. This is because if the client can find everything in Internet, then he or she will not call the shipping company to solve his or her doubts. For example, concerning the tracking concept, information about a container one day is not available until the day after, so the information is delayed in Internet.

Another very important condition for the carriers when choosing a port in Europe is the round trip amount of containers shipped. For example, if a carrier sends 400 containers weekly from mainland China to Barcelona but only 100 of them go back to mainland China loaded, then the fixed costs for the company are very high. That is why the rotation of the maritime services offered by the carriers interviewed is related to the amount of round trips offered by that port.

All in all, it is important to take into account that only a 10% of the total cost of shipping a container from mainland China to Europe is due to the Port conditions and requirements at destination. The other 90% of this cost is in terms of petrol, investment in new vessels and labour costs. Moreover, the most important thing when selecting a destination port in Europe is where the consumption market is. If a port is very efficient and well connected to the hinterland but there is no hinterland to feed, then that port will not be much used. That is the main reason why today the 75% of containers transported from mainland China to Europe are directed to the North instead of the South.

And this is also the reason why some carriers have closed some of the maritime services offered from mainland China to the Mediterranean Europe in the last year. This is the case of

APL, which has a 6 vessels fleet operating the European ports: 5 of them operate in the North of Europe (capacities 8.000 TEU (1), 11.000-12.000 TEU (3) and 14.000 TEU (1)) and only 1 in the Mediterranean Sea (capacity 8.000 TEU). Before they had 2 vessels operating in the Mediterranean Sea, but in October 2013 they decided to close one of them because it was not profitable. A similar thing happened to NYK as a part of the G6 alliance.

Finally, a relatively new important decision variable for some carriers like COSCO when choosing a transhipment port in Europe is the green logistics chain. These carriers are trying to convince its customers about the necessity of using an environmentally friendly way of transporting goods. In that sense, exporting containers from mainland China to North Europe instead of the Mediterranean Europe implies 20% more petrol consumption. That is why these carriers are introducing to its customers the possibility of using Southern Europe ports as a south gate to Europe, as in the future this green logistics chain will become more and more crucial in the exportation of containers from mainland China to Europe.

When shipping from mainland China to Europe, most of the carriers prefer to concentrate big volumes in traffics with a lower number of scales, feeding later other ports by feeder services; rather than offering traffics with a high number of scales (reducing transit operations). Therefore, the type of port preferred by them is a hub port rather than a gateway port. This option is always the preferred one by the customers. However, there are some carriers that prefer to offer maritime services with a higher number of scales, reducing transit operations, rather than concentrating big volumes in traffics with a lower number of scales. This is because they care a lot about the loading condition of the containers, and the way of ensuring that the containers shipped are loaded is by doing a large number of scales.

Concerning the services that can be improved in the European Mediterranean ports, the carriers interviewed suggest different improvements for different ports. However, it must be said that in general they all recognized that all the European Mediterranean ports belong to developed countries, so the differences between them are not very high. These short differences, together with the current European economic situation and the location in North Europe of the consumption market, suggest that the Mediterranean port election is relatively stable and that no big changes will occur in it.

In general, the port improvements suggested by carriers can be classified into two types: hardware and software. The hardware is related to the port facilities, the connections to the hinterland, infrastructure condition, etc.; while the software is related to the way of working of each port, its tracking capability, management, etc. It is evident that a port having a good software but not so good hardware means it can release cargo smoothly but it has not enough facilities to arrange it. On the other hand, a port having a good hardware but not so good software means it will have problems when unloading and loading the cargo. Therefore, both hardware and software must be in equilibrium.

After interviewing some of the main shipping companies transporting containers from mainland China to European Mediterranean ports, it is concluded that Italian ports (Genova, Livorno, La Spezia, Napoli, Gioia Tauro) should improve their hardware. Some of these ports have problems with their equipment facilities or railway connections. Their main problem is that they cannot combine the local cargo distribution with the transhipment distribution. For example, Gioia Tauro and Taranto are pure transhipment ports, while La Spezia, Genova, Livorno, etc. are pure local cargo ports.

On the other hand, Spanish ports like Valencia and Barcelona combine efficiently the local cargo distribution and the transhipment services because both are important for them. Almost all the shipping lines call these two ports because they have good connections to everywhere, especially to Africa. However, the problem of these Spanish ports is the software: customs offices have different and very complicate policies. And also another important service to improve from these ports is the business manners: for the transhipment activities from Valencia and Barcelona now you need the support of local companies because they do not have an international view. In conclusion, although Barcelona and Valencia ports hardware is good enough, the local business efficiency is not high enough. This is also related to the congestion problems noticed by some carriers in these ports: sometimes they have to wait outside the port for one day or more. This specially affects Valencia, which in the past years has been a busy port, which implies that a sudden unexpected increasing demand could not be processed in time because of its high degree of saturation. However, it seems that the situation in terms of saturation in Barcelona and Valencia now is better because the volume handled has been significantly reduced due to the economic crisis.

In addition, Greek and Turkish ports have a special advantage because of their good location. That is why some carriers like COSCO have invested a lot of money there in the past few years. They think that in the future the Black Sea market will be very important because it will be well connected by railway and road to Central Europe. However, some carriers have suggested that Piraeus should improve its reliability – it has a bad reputation of successive strikes that completely stopped its operations for long periods of time – and that Ambarli should improve its berthing facilities – the terminal is not up to date in terms of the facilities, in comparison to the importance it has gained in the past few years –.

On another hand, from the interviews it has been noted that in Marseille Fos there are a lot of problems concerning the labour conditions, which implies that a large number of working days the Port is not operating properly. From the carriers point of view this is an important issue because they operate from mainland China and they cannot do anything about it.

Finally, an important port today when exporting containers from mainland China to North Africa is Tanger MED. After the interviews it was noticed that the loading and unloading capacity of the port is not good enough because its facilities are quite old.

The shipping industry is an industry that has lost a lot of money, and it will not be in equilibrium again because all the shipping companies are investing a lot of resources in order to get more optimized vessels to reduce costs and therefore reduce prices. This is a vicious circle from which the only possible solution is to create alliances. Therefore, after interviewing the main carriers exporting containers from mainland China to Europe, the conclusion is that the future tendency shows that more alliances will be created.

A prove of that is that recently new alliances have been created. The most famous one is the P3 Alliance, which starts running July 2014, and that consists of an alliance between Maersk, MSC and CMA CGM. What they will do is to sell slots to different shipping companies minimizing the costs. They are based in London (UK).

Another prove of this future tendency is the recently created G6 alliance. The G6 alliance, formed by APL, NYK, Hapag-Lloyd, MOL, OOCL and Hyundai, operates since April 2014 mostly in the Northern Europe. Before, there exist the Grand Alliance (OOCL, NYK and Hapag-Lloyd) and the New World Alliance (APL, MOL and Hyundai). These two alliances were operating both the transpacific and transatlantic routes, and they decided to work together from this year.

This is also the case of the Green Alliance, formed by COSCO, K Line, Yang Ming Line Hanjin and Evergreen. Before the alliance was only constituted by COSCO, K Line and Yang Ming Line, but after Hanjin joined and in April 2014 Evergreen joined as well.

However, it is also true that currently all the main carriers operate in alliances, and therefore the velocity of changing or creating new alliances will decrease in the next years. Only if any of the carriers disappear from the market or if some unexpected phenomenon occurs, there can be changes in the current existing alliances.

Most of the shipping companies interviewed currently have leverage in some European Mediterranean ports. For example, MSC has leverage in Genova, La Spezia, Marseille, Tanger MED, Valencia and Napoli; Maersk in Algeciras, Tanger MED, Gioia Tauro and Port Said; CMA CGM in Malta, Tanger MED and Marseille; COSCO in Piraeus, Napoli and Port Said; Hanjin in Algeciras; and Evergreen in Taranto. Others do not have leverage in European Mediterranean ports, but they do in Northern European ports. For example, CSCL has leverage in Zeebrugge and APL in Rotterdam and Hamburg.

In the future, the intentions of carriers show very divergence tendencies about this aspect. Some of the shipping companies interviewed such as MSC, COSCO and Maersk are interested in acquiring new terminals in European ports, because after they can save a lot of money for using them. Some others, such as APL and CSCL, currently do not have leverage in any European port; because their current strategies do not consist in invest in terminals. However, in the future, they do not discard to acquire a terminal or buy some shares in a terminal, especially in upcoming economies such as North African ones. Finally, some other carriers such as CSAV and NYK do not plan to invest in new terminals in the European Mediterranean ports in the near future because they think that the Mediterranean market has been poor for a long time and no big changes are expected in the near future.

About the future fleets operating from mainland China to Europe, some carriers plan to introduce newer and bigger vessels, and some others do not. For example, MSC's biggest vessel has 16.000 TEU capacity, and they think it is enough big for the services they offer. The same happens with CMA CGM, which will introduce in the third quarter of 2014 its biggest vessel until now of 16.000 TEU capacity, included in the P3 Alliance with Maersk and MSC. CMA CGM believes all the ports in the Mediterranean Europe are well prepared for receiving these 16.000 TEU capacity vessels. They insist, however in the fact that they are facing difficulties when trying to export containers from mainland China to Hamburg. In their opinion, Hamburg is not an efficient port because it is very old and it has depth problems, despite its large tradition for being a transhipment port. That is why CMA CGM, together with the P3 alliance, will operate their vessels in Wilhelm burg, a new port close to Hamburg with improved facilities and with a huge potential.

This is different from other shipping companies such as CSCL, which already ordered to Korea the construction of three new 18.000 TEU capacity vessels. CSCL insists that the European economy is in North Europe, and that only changes concerning the transport of containerized goods from mainland China to North Europe will be applied. For example, currently the 8.500 TEU capacity vessels are being used for the transport of containers from mainland China to the Mediterranean Europe by CSCL, while 14.000 TEU capacity vessels are being used for the transport of containers from mainland China to North Europe by CSCL. While for the Mediterranean Europe no changes are expected in short term, in the case of North Europe in the next year 18.000 TEU capacity vessels will be introduced by CSCL in order to operate the Far-East to Europe routes.

Another carrier that is producing an 18.000 TEU capacity vessel is Maersk, because it pursues economies of scale. That is because a 40% of the cost of shipping a container is in petrol, so the larger amount a vessel can carry, the more money it can be saved. However, producing bigger vessels might induce limitations when selecting the origin and/or destination Port. Maersk does not plan to produce vessels bigger than 18.000 TEU, but is constantly trying to optimize its vessels in order to carry more TEU in the same size vessel without limiting the Ports technical conditions.

On the other hand, NYK does not consider the possibility of introducing vessels of capacity 18.000 TEU. NYK thinks that the vessels of capacity 14.000 TEU are more efficient and ecological than the 18.000 TEU ones. Moreover, NYK thinks that the higher the capacity of the vessel, the larger the number of stops in the rotation in order to completely load it. NYK ordered in May 2014 the construction of 4 new 14.000 TEU capacity vessels, and they are considering the option of buying 4 more. These 4 new vessels will operate in Northern Europe, therefore displacing some of the current vessels operating in the North to the Mediterranean Sea. The new vessels will be more efficient, safe, ecologic and profitable than the old ones, and that is the reason why NYK wants to replace them.

Similar to NYK there is COSCO, which thinks that the shipping industry will not go back to the same situation as before 2008. Now the shipping industry has over capacity, and then COSCO thinks it is not a good idea to invest in big vessels. They are ordering and they will order new vessels, but only to replace the old ones. The new orders are vessels bigger than the current ones, but around 13.000-14.000 TEU capacity (no intention of introducing 18.000 TEU capacity vessels). In the Mediterranean Sea COSCO plans to increase the capacity of the operating vessels, but at the same time reduce the number of them.

It is of special interest the change in business strategy applied by COSCO. Now they are thinking about reducing the operations in some Mediterranean ports step by step. Instead, they will invest in big capacity vessels that will call fewer ports. For instance, last year COSCO called directly at Napoli, but now it uses feeder services from Piraeus to serve it. The intentions of COSCO are justified by saying that the bigger the vessel, the fewer the number of calls. In part this is because not all ports can receive these big vessels. COSCO states that 3.000-4.000 TEU capacity vessels can call a lot of ports and after provide door-to-door services, but 15.000 TEU capacity vessels cannot call a lot of ports because then the transit times will be too high.

In summary, the main conclusions extracted from the interviews to carriers are:

- The carriers operating from mainland China to the European Mediterranean ports do not call at every port, but only at a few selected ports. The main reason for using some ports and not some others is either the gateway role of the port or its hub and spoke role.

- Concerning the decision variables when selecting a transhipment port in Europe (hub and spoke), everything is simplified to an optimization problem, where the objective is to reduce the cost. However, for that purpose the first thing to do is determine where the demand is.

- Regardless the monetary costs, the technical condition of the terminal, the transit policies of the port (customs declaration, inspections, etc.) and the degree of saturation (rate of usage) of it are very important factors. Moreover, the services and facilities in the terminal and the proximity to the hinterland destination are also quite important. Finally, the alliance, the sea distance from the origin port, the communication / language / customer service and all the e-commerce services are the less important decision criteria.

- Only a 10% of the total cost of shipping a container from mainland China to Europe is due to the Port conditions and requirements at destination. The other 90% of this cost is in terms of petrol, investment in new vessels and labour costs.

- In most of the cases, carriers work together in order to optimise their vessels and get higher load factors.

- All the maritime services have a significant rate of transhipment that is lower or higher as a function of the operating ports. Most of the carriers do not have their own feeder services in the European Mediterranean ports; normally they use common feeders. This fact contrasts with Port of Barcelona, where 92% of transits are fed up by dedicated feeder networks, and only an 8% of transits are covered by public feeders.

- No big changes are expected in the current feeder networks in the Mediterranean Europe for the future. The Mediterranean is a very stable market that feeds a hinterland – the South European – that in the past few years has been decreasing its demand due to the economic crisis. Only CMA CGM plans to increase its maritime services offered from Asia to the Mediterranean.

- With other parts of the World, especially with Africa, there will be a lot of changes in the shipping industry. The number of shipping services between mainland China and Africa will increase a lot in the next years.

- All depends on economics: if there is a region in the Mediterranean that is developing faster, then carriers will use it as their entry to Europe.

- Some carriers are starting to give an increasing importance to the green logistics chain. For example, COSCO. These carriers are trying to convince their customers about the necessity of using an environmentally friendly way of transporting goods.

- When shipping from mainland China to Europe, it is not clear which is the preferred option for carriers: some prefer to concentrate big volumes in traffics with a lower number of scales, feeding later other ports by feeder services; and some others prefer to offer traffic with a higher number of scales (reducing transit operations and ensuring the loading of containers).

- For carriers, Italian ports should improve their hardware, Spanish ports their software and degree of saturation, Greek and Turkish ports their reliability and berthing facilities, Marseille Fos its labour conditions and the North African ports their facilities.

- The shipping industry has lost a lot of money in the last years, and it will not be in equilibrium again. That is why the future tendency shows that more alliances will be created.

- Most of the existing shipping companies have leverage in some European Mediterranean ports. In the future, the intentions of carriers show very divergence tendencies about this aspect. Some are interested in acquiring new terminals (MSC, COSCO and Maersk); some others currently do not have leverage but do not discard investing in some ports (APL and CSCL); and finally some do not plan to invest in any European Mediterranean port (CSAV and NYK).

- Some carriers will introduce bigger vessels of 18.000 TEU capacity in their fleet (CSCL and Maersk). However, it will only operate in the Northern Europe. Some other carriers state that the 16.000 TEU capacity vessel is the biggest they will introduce (MSC, CMA CGM), and some others have enough with 14.000 TEU capacity vessels NYK, COSCO).

4. Identification of expected future changes affecting the current model

4.1. Scenario definition

Before identifying the future tendencies in the exportation of containers from mainland China to Europe, a review of what has been done until now should be described here.

The first part of this study consisted in modelling and describing what is the current situation in the container flow from mainland China to each of the selected European ports. This allowed us to visualize which is the importance of each port in Europe when the commercial partner is mainland China. This part includes also a detailed research about what is in each case the rate of empty containers transported, the rate of transhipment in each port and the use of inland waterways if existing. Therefore, it was determined which ports are gateway ports and which others are hubs. Out of the European Mediterranean ports analysed, Barcelona, La Spezia, Genova, Marseille Fos and Tanger MED are gateway ports because they feed a hinterland with enough demand to avoid them having a high rate of transhipment. On the other hand, Malta, Gioia Tauro and Algeciras, with more than a 85% of transhipment of the cargo coming from mainland China, are hub and spoke ports thanks to their good location in the main maritime routes from the Far-East to Europe and to their transit policies. Valencia, with a 38% of transhipment, can be considered both a hub port and a gateway port.

In this part of the study it can be seen as well how a 75% of all the cargo exported from mainland China to Europe is unloaded in the Northern range of ports rather than in the Southern range. Ports like Rotterdam, Le Havre, Antwerp, Hamburg, Zeebrugge, etc., receive much more cargo from mainland China than their competitors in the Mediterranean Sea. The main reason for that, regardless the ports by themselves, is the location of the European consumption market in the North.

Once modelled and described the current situation of the container flow from mainland China to Europe from the ports' point of view, interviews to the main carriers operating maritime services between these two areas were executed. These interviews were used for two main reasons:

- First, to verify that the current container flow from mainland China to Europe is the one drawn in the first chapter. The carriers are the shipping companies that decide which are the maritime services that should be offered in order to satisfy the needs of the customers. Therefore, the container flow from China to Europe depends only in the services offered by them. From the interviews it was confirmed that the Northern Europe bigger demand justifies that a 75% of the cargo coming from mainland China is directed to there. Inside the Mediterranean, from these interviews it could also be seen how some ports are more important than others, depending on the role they play.

- Second, to find out the future changes that these shipping companies will introduce in their vessels, the future potential alliances between companies and their intentions of investing in some Mediterranean Ports, in order to get some clues about the future scenario in the exportation of containerised goods from China to the Mediterranean Europe.

In the previous chapter about the interviews' conclusions the information about these future changes was included. Here it will be developed in detail.

According to the carriers' point of view, the Mediterranean market has been stable during the last years, and even slightly decreasing due to the economic recession affecting Europe. From all the economic organizations, no big improvements are expected in the European economy, especially in the Southern one.

In accordance to this economic market stability, carriers do not expect big changes in the current feeder networks offered in the Mediterranean Europe. For example, MSC does not plan to apply any change in terms of feeder services offered from the Mediterranean Europe market. MSC will keep exporting a lot of cargo from mainland China to England by feeder services from a Mediterranean European Port, as they have been doing until now. However, it is true that for MSC the limitation of 2.000 TEU capacity of the current feeder vessels may be increased to 4.000 TEU in the near future.

Also COSCO has its own feeder services in Europe, but not so many. Currently, COSCO has its own feeder services from Piraeus to Turkey and to the Black Sea. From Barcelona and Valencia COSCO uses the common feeder services. They state that in the future they will invest in their own feeder services from the Mediterranean Ports.

Apart from these small changes applied by COSCO and MSC, other carriers such as CSCL, NYK and CSAV stated that no plans of changes are expected for the Mediterranean Europe. The reason of that is that there is not a big enough consumption market in the South of Europe. If someday the situation changes and the Southern Europe economy is as big as the Northern Europe, then CSCL will change all its routes and redirect them to the South, but nowadays there is no Southern country able to compete with the Northern ones.

Only CMA CGM stated that in the near future plans to increase its current 5 maritime services from Asia to North Europe to 8 and its current 3 maritime services from Asia to the

Mediterranean Europe to 5. This means that the company plans to increase its offer both in Northern and Southern Europe.

On the other hand, with other parts of the World, especially with Africa, there will be a lot of changes in the shipping industry. In 2013 Xi Jinping, China's former president, went to Africa and gave a lot of money to the local people with the only condition that they must buy products made in China. This means that the number of shipping services between mainland China and Africa will increase a lot in the next years. MSC, for example, will introduce in June 2014 a new service called Africa Express, which will go directly from the main Chinese ports to the main African Ports.

When talking about door-to-door services, after the interviews seems that carriers do not plan to offer new services of this type. Actually, all depends on economics: if there is a region in the Mediterranean that is developing faster, then carriers will use it as its entry to Europe. When suggested about the East of Europe market, which is growing very fast in the recent years, carriers stated that the Eastern Europe is served from Hamburg rather than from the Mediterranean Sea.

Only CMA CGM stated that they have a very strong door-to-door service, because they have relations with all the logistics companies operating in the main European ports. In the future they specially have interest in increasing these door-to-door services, but they also plan to increase the hub and spoke services and the transits to transoceanic routes.

The shipping industry is an industry that has lost a lot of money, and it will not be in equilibrium again because all the shipping companies are investing a lot of resources in order to get more optimized vessels to reduce costs and therefore reduce prices. This is a vicious circle from which the only possible solution is to create alliances. Therefore, after interviewing the main carriers exporting containers from mainland China to Europe, the conclusion is that the future tendency shows that more alliances will be created.

A prove of that is that recently new alliances have been created. The most famous one is the P3 Alliance, which starts running July 2014, and that consists of an alliance between Maersk, MSC and CMA CGM. What they will do is to sell slots to different shipping companies minimizing the costs. They are based in London (UK).

Another prove of this future tendency is the recently created G6 alliance. The G6 alliance, formed by APL, NYK, Hapag-Lloyd, MOL, OOCL and Hyundai, operates since April 2014 mostly in the Northern Europe. Before, there exist the Grand Alliance (OOCL, NYK and Hapag-Lloyd) and the New World Alliance (APL, MOL and Hyundai). These two alliances were operating both the transpacific and transatlantic routes, and they decided to work together from this year.

This is also the case of the Green Alliance, formed by COSCO, K Line, Yang Ming Line Hanjin and Evergreen. Before the alliance was only constituted by COSCO, K Line and Yang Ming Line, but after Hanjin joined and in April 2014 Evergreen joined as well.

However, it is also true that currently all the main carriers operate in alliances, and therefore the velocity of changing or creating new alliances will decrease in the next years. Only if any of the carriers disappear from the market or if some unexpected phenomenon occurs, there can be changes in the current existing alliances.

Another important variable to take into account when analysing the future scenario in Europe is the leverage of carriers in European ports. Some of the shipping companies interviewed such as MSC, COSCO and Maersk are interested in acquiring new terminals in European ports, because after they can save a lot of money for using them. Some others, such as APL and CSCL, currently do not have leverage in any European port; because their current strategies do not consist in invest in terminals. However, in the future, they do not discard to acquire a terminal or buy some shares in a terminal, especially in upcoming economies such as North African ones. Finally, some other carriers such as CSAV and NYK do not plan to invest in new terminals in the European Mediterranean ports in the near future because they think that the Mediterranean market has been poor for a long time and no big changes are expected in the near future.

But probably the most important variable that will define the future scenario in the exportation of containers from mainland China to Europe is the future fleets in operation. In that way, some carriers plan to introduce newer and bigger vessels, and some others do not. For example, MSC's biggest vessel has 16.000 TEU capacity, and they think it is enough big for the services they offer. The same happens with CMA CGM, which will introduce in the third quarter of 2014 its biggest vessel until now of 16.000 TEU capacity, included in the P3 Alliance with Maersk and MSC. CMA CGM believes all the ports in the Mediterranean Europe are well prepared for receiving these 16.000 TEU capacity vessels. They insist, however in the fact that they are facing difficulties when trying to export containers from mainland China to Hamburg. In their opinion, Hamburg is not an efficient port because it is very old and it has depth problems, despite its large tradition for being a transhipment port. That is why CMA CGM, together with the P3 alliance, will operate their vessels in Wilhelm burg, a new port close to Hamburg with improved facilities and with a huge potential.

This is different from other shipping companies such as CSCL, which already ordered to Korea the construction of three new 18.000 TEU capacity vessels. CSCL insists that the European economy is in North Europe, and that only changes concerning the transport of containerized goods from mainland China to North Europe will be applied. For example, currently the 8.500

TEU capacity vessels are being used for the transport of containers from mainland China to the Mediterranean Europe by CSCL, while 14.000 TEU capacity vessels are being used for the transport of containers from mainland China to North Europe by CSCL. While for the Mediterranean Europe no changes are expected in short term, in the case of North Europe in the next year 18.000 TEU capacity vessels will be introduced by CSCL in order to operate the Far-East to Europe routes.

Another carrier that is producing an 18.000 TEU capacity vessel is Maersk, because it pursues economies of scale. That is because a 40% of the cost of shipping a container is in petrol, so the larger amount a vessel can carry, the more money it can be saved. However, producing bigger vessels might induce limitations when selecting the origin and/or destination Port.

In order to find out which ports in the Mediterranean Europe would be able to receive these 18.000 TEU capacity vessels, a research was carried out about the technical conditions of all the terminals operating now in these European ports. A summary of the main results is compiled in the following table:

Table 173. Technical conditions of the selected European Mediterranean ports terminals and their capacity to accept the new 18.000 TEU capacity vessels

Port	Terminals	Berthing line (m)	Depth (m)	Area (ha)	Capacity (TEU)	Type of crane	Number of cranes	Can accept the new 18.000 TEU capacity vessels	Reference
Barcelona	TCB	1.512 (2)	16 (1)	57 (2)	1,4 M (2)	Panamax (1)	6	YES	(1) http://www.tcbcn.com (2) Port of Barcelona information
						Super-Post Panamax	8	YES	
	TerCat BEST – Moll Prat	1.500 (2)	18 (2)	132 (2)	2,6 M (2)	Super-Post Panamax	8	YES	(1) http://www.tercat.es/index_cast.html (2) Port of Barcelona information – BEST
Marseille Fos	Mourepiane Container Terminal	952	11,5	32	250.000	STS	6	NO	http://www.worldportsource.com/ports/commerce/FRA_Port_of_Marseille_89.php http://www.tilgroup.com/terminal/port-marseille http://www.eurofos.fr/files/fiche%20descriptive%20du%20terminal%20ang.pdf http://www.eurofos.fr/en/main/company/terminal/page/1 STATS TEU: http://www.marseille-port.fr/fr/Page/Les%20chiffres/13109/fixed http://www.med-europe-terminal.com/en_US/le-
	FOS2XL Terminal	830	16	52	900.000	STS	5	YES	
	Eurofos Terminal	1.600	14,5	76,3	1 M	Panamax	2	NO	
						Post Panamax	6	NO	
						Super-Post Panamax	3	NO	
	Med Europe Terminal	925	11,4	33	9.600	Panamax	4	NO	

									terminal/moyens-materiels/
Valencia	TCV	1.660	9-16	37	1,25 M	Panamax	2	**YES**	http://www.tcv.es/ES/infraestructura.html http://www.noatum.com/es/noatum-ports/valencia/ STAT:http://www.puertos.es/sites/default/files/memorias_anuales/2011/index.html http://www.tilgroup.com/terminal/port-valencia
						Post Panamax	4	**YES**	
						Super-Post Panamax	3	**YES**	
	Noatum ContainerTerminal Valencia	2.318	16	158	2 M	Over Super-Post Panamax	10	**YES**	
						Super-Post Panamax	4	**YES**	
						Post Panamax	4	**YES**	
						Panamax	1	**YES**	
	MSC Terminal Valencia	770	16	35	1,6 M	Super-Post Panamax	8	**YES**	
Algeciras	APM Terminal	2.124	16	67	3,1 M	Post Panamax	9	**YES**	http://www.apmterminals.com/europe/algeciras/default.aspx STATS:http://www.apba.es/apba/Memoria2012/ESP/HTML/memoria.html http://www.ttialgeciras.com/index.php?option=com_content&view=article&id=9&Itemid=14&lang=esp
						Super-Post Panamax	10	**YES**	
	TTI Terminal Algeciras	1.200	18,5	60	1,6 M	Super-Post Panamax	8	**YES**	
Tanger MED	APM Terminals Tangier, S.A.	800	16	40	1,7 M	Super-Post Panamax	8	**YES**	http://www.portoverview.com/data/4.pdf
	EUROGATE Tanger, S.A.	800	18	40	1,3 M	Super-Post Panamax	8	**YES**	
						Super-Post	6	**YES**	

Malta	Terminal One	1.000	16,5	45,75	1,5 M	Panamax			http://www.maltafreeport.com.mt/freeport/content.aspx?id=111332 STAT:http://www.maltafreeport.com.mt/content.aspx?id=107940 http://www.maltafreeport.com.mt/freeport/content.aspx?id=107941
						Post Panamax	4	YES	
	Terminal Two	480	17	22,5	1,5 M	Super-Post Panamax	12	YES	
Genova	SECH Terminal	526	14,5	20,6	500.000	Super-Post Panamax	5	NO	http://www.porto.genova.it/index.php/en/the-genoa-port/port-today/the-structure/terminal-and-port-operators/port-operators/385-voltri-terminal-europa http://www.sech.it/web/ita/home.jsp
	Voltri Terminal Europa	1.200	15	100	1,3 M	Post Panamax	8	YES	
La Spezia	Contship	(520-467-265)	14	32,9	1,2 M	Post Panamax	7	NO	http://www.contshipitalia.com/en/marine_lsct.htm
						Panamax	2	NO	
Cagliari	CICT	1.520	16	40	1,2 M	Post Panamax	7	NO	http://www.cacip.it/it/come-operiamo/macchiareddu/cict/cict.php
Gioia Tauro	Medcenter Container Terminal	3.391	16	120	4 M	Super-Post Panamax	22	YES	http://www.apmterminals.com/europe/gioiatauro/default.aspx STATS:http://portodigioiatauro.it/sviluppo.php?id=5

The main characteristics of the new 18.000 TEU capacity vessels that Maersk and other shipping companies like CSCL will introduce in their vessels are:

- Type of vessel: Triple E class.
- Tonnage: 165.000 dwt.
- Length: 400 m.
- Hose: 59 m.
- Draft: 14,5 m.
- Capacity: 18.000 TEU.

After the research summarised in Table 173, the European Mediterranean ports capable of adapting to the new vessels that Maersk and CSCL will introduce are: Barcelona, Valencia, Algeciras, Tanger MED, Malta, Gioia Tauro, Genova (Voltri) and Marseille Fos (2XL). Other ports such as Cagliari, La Spezia and some terminals in Marseille Fos and Genova are not ready to receive such big vessels.

Although this makes us think that some redistribution of the cargo across the Mediterranean Sea will be done, the two shipping companies that will introduce these bigger vessels confirmed their intentions of operating them in the North of Europe rather than in the South. Therefore, similar to the conclusions extracted before about the feeder networks in the Mediterranean Sea, no big changes are expected in this area.

On the other hand, NYK does not consider the possibility of introducing vessels of capacity 18.000 TEU. NYK thinks that the vessels of capacity 14.000 TEU are more efficient and ecological than the 18.000 TEU ones. Moreover, NYK thinks that the higher the capacity of the vessel, the larger the number of stops in the rotation in order to completely load it. NYK ordered in May 2014 the construction of 4 new 14.000 TEU capacity vessels, and they are considering the option of buying 4 more. These 4 new vessels will operate in Northern Europe, therefore displacing some of the current vessels operating in the North to the Mediterranean Sea. The new vessels will be more efficient, safe, ecologic and profitable than the old ones, and that is the reason why NYK wants to replace them.

Similar to NYK there is COSCO, which thinks that the shipping industry will not go back to the same situation as before 2008. Now the shipping industry has over capacity, and then COSCO thinks it is not a good idea to invest in big vessels. They are ordering and they will order new vessels, but only to replace the old ones. The new orders are vessels bigger than the current ones, but around 13.000-14.000 TEU capacity (no intention of introducing 18.000 TEU capacity vessels). In the Mediterranean Sea COSCO plans to increase the capacity of the operating vessels, but at the same time reduce the number of them.

It is of special interest the change in business trategy applied by COSCO. Now they are thinking about reducing the operations in some Mediterranean ports step by step. Instead, they will invest in big capacity vessels that will call fewer ports. For instance, last year COSCO called directly at Napoli, but now it uses feeder services from Piraeus to serve it. The intentions of COSCO are justified by saying that the bigger the vessel, the fewer the number of calls. In part this is because not all ports can receive these big vessels. COSCO states that 3.000-4.000 TEU capacity vessels can call a lot of ports and after provide door-to-door services, but 15.000 TEU capacity vessels cannot call a lot of ports because then the transit times will be too high.

In conclusion, although in the near future no big changes are expected in the shipping industry affecting the maritime services currently offered from mainland China to Europe, some of the carriers' intentions were found out through the interviews and summarised here. Some of these intentions involve the introduction of bigger vessels in their fleets and the maintenance or slightly increasing of the maritime routes offered. Therefore, some opportunities will arise for the Mediterranean European ports to participate more in the future and receive more traffics coming from China.

In order to play a more important role in this future scenario, it is crucial for a port to define in advance its role as a gateway port or as a hub and spoke port. Moreover, some other strategies shall be well established by a port in order to be competitive in this future scenario. This optimisation will be defined in the next chapter, and applied to the case of Port of Barcelona, as this study was executed at Port of Barcelona Chair of Logistics at CEIBS (Shanghai).

4.2. Flow optimization focused on Barcelona

World-wide distributed production and consumption is the trigger of globalisation, and is only possible through effective and efficient transport chains. Container shipping is the most visible transport but one must not forget about break bulk and project cargo, solid and liquid bulk cargo, liquefied and pressurised gas and specialised transports ranging from cars to cattle. By a large margin, most of these cargoes that are transported around the world, and in particular from mainland China to Europe, are carried by ships, and ports are the vital interface from sea transport to other modes or again to ships to distribute the goods along the coasts and inland waterways.

As research topic goes, seaports do not have a long history and this is because the industry has always relied on its practical experience, and success has proved it right in the past. However, the port business environment has gone through, and still goes through, significant changes. New solutions are needed and these solutions can no longer be based on experience alone.

Extrapolating the past will certainly not result in optimum future solutions so science will have to play a stronger role within the port industry. The current economic crisis adds to the challenges but also paves the way for increased acceptance of research as many of the tools, having been successful in the past, currently show inadequacies.

Nobody could foresee the current economic crisis when the European Commission's Directorate General Research launched a port-specific project within the 6th Framework Programme for Research and Technological Development but EFFORTS, the acronym for Effective Operations in Ports, was perfectly timed when it began, in May 2006 – to become concluded in October 2009 –. Before the crisis the main headaches of ports were to cope with continuously increasing transport volumes, but now it becomes a question of economic survival to manage port processes in the most competitive way. The term "competitive" here is not restricted to cost-efficient but also covers environmental and socio-economic issues.

As said in the previous chapter, the most important variable that will define the future scenario in the exportation of containers from mainland China to the Mediterranean Europe is the new size of the vessels in operation.

Although for the moment none of the carriers plan to introduce the 18.000 TEU capacity vessels in the Mediterranean Europe, it is possible that in the near future shipping companies decide to consolidate cargo into bigger vessels. For example, if COSCO and CSCL are currently operating 9.000 TEU capacity vessels from mainland China to Barcelona respectively, maybe soon they will use together an 18.000 TEU capacity vessel instead. This way they both will reduce costs.

Thus, in spite of being true that a port by itself cannot increase the cargo demand, it can miss big opportunities of increasing market shares if it does not adapt its terminals to the newest vessels of high capacities. For example, in the case described above, if Valencia was ready to receive the 18.000 TEU capacity vessels and Barcelona not, carriers would probably use Valencia as their gateway port and distribute the cargo for Barcelona by railway.

And even a port like Barcelona has not enough hinterland demand to receive an 18.000 TEU capacity vessel, the free space in the vessel could be used for example for the cargo transshipped to North Africa.

So, according to the research done here and to the interviews executed in Shanghai to the main shipping companies operating Far-East to Europe maritime routes, in the near future the Mediterranean ports should focus their efforts in the following three measures:

- To reduce their operational costs. Nowadays these costs are mainly labor costs related to the stevedoring companies.

- To improve their agility in terms of loading and unloading cargo and their communication facilities with the carriers. Here it must be said that normally is not the port but the customs office who should improve these services.

- To adapt their infrastructure to the new 18.000 TEU capacity vessels.

And in order to get higher market shares these three measures should be improved when related to transshipment cargo. The local cargo is not as volatile as the transshipment cargo because there are fewer options when choosing a gateway port for a specific area.

The transhipment of containers gives competitive advantages to the considered port, because it develops a bigger amount of regular maritime services, and therefore develops enough critical mass to the maintenance of this traffic, as well as absorbing other types of traffic with origin/destination the hinterland.

For the Port Authority, the larger the number of scales, the larger the benefits it has. Transits involve a larger volume of handling per ship, which implies a potential larger profitability and a reduction in the stevedore unitary cost in that terminal, as well as providing them a larger productivity and competitiveness.

It is obvious that a larger traffic volume in a terminal implies the necessity of increasing the stevedore human resources and at the same time implies a larger availability and flexibility in the hiring process of this port service.

However, from a carrier point of view, transits represent a cost. This means that their criterion in this aspect is based on cost reduction, and the port transhipment selection is done in terms of cost reduction. This means that this kind of transits can be very volatile and imply mid and long-term uncertainty, as they do not have the hinterland as their final destination.

Currently, two different carrier’s transit policies can be distinguished:

- Carriers that concentrate big volumes in traffics with a low number of scales in transoceanic ships, providing afterwards feeder services to other ports. For example, Maersk.

- Carriers that using transoceanic ships do a high number of scales, reducing therefore their transit operations. Although they reduce their transshipment rate, as they cannot scale in all the ports, there will always be a certain rate of transshipment.

The following map shows the positioning of carriers in the Mediterranean Sea:

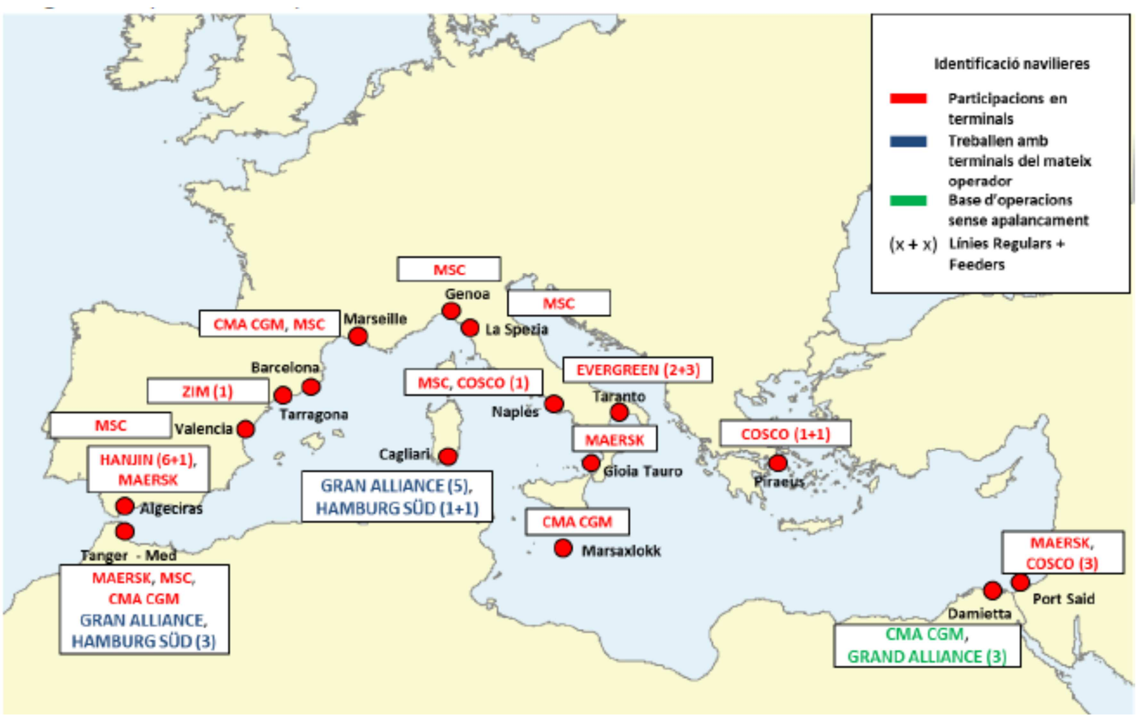


Figure 105. Positioning of the main carriers in the Mediterranean Sea (*source: Port Authority of Barcelona*)

The two main factors that explain this positioning of the carriers in the Mediterranean ports are:

- Geographic situation close to the main navigation route, which is the Suez-Gibraltar route.

- Leverage rate in the terminals. There are three possible situations: participation of carriers in the terminals shareholding, carriers that are clients of the same terminal operator with presence in different ports, and non-leverage carriers when the port is in a geographic position close to the main route.

The situation is different concerning hub ports (interlining + hub and spoke) than concerning gateway ports (hub and spoke). In the case of hub ports the geographical situation close to the main navigation route is more important than the carriers' leverage rate in the terminals, while in the case of gateway ports the geographic situation is not as important the leverage rate in the terminals.

The following matrix shows in a double axis the position of the main Mediterranean ports when both factors are combined, and it shows the weak situation of Barcelona in the market of transits:

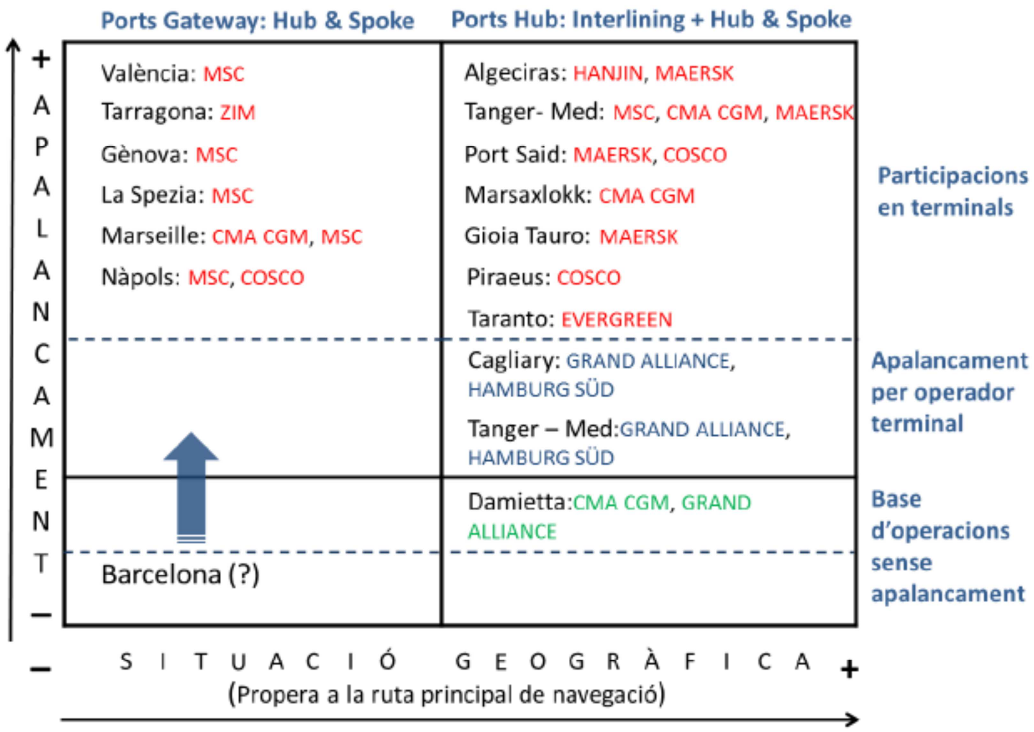


Figure 106. Gateway ports and hub ports in the Mediterranean Sea (*source: Port Authority of Barcelona*)

Barcelona, as a gateway port, is not in a favorable geographic situation to catch a big percentage of transits. Moreover, it does not have any carrier installed or leveraged in any of its terminals. Therefore, Barcelona is not in a favorable situation concerning transits.

There are three different types of transits depending on which transshipment operation from the Port is executed:

- Hub and spoke transshipment. The Port acts like a distribution and reception maritime center in the Occidental and Oriental Mediterranean, North and West Africa, markets which constitute the maritime hinterland of the Port, of the traffic flows coming from the main intercontinental origin/destination lines (Europe-Far East, Transatlantic, South America routes).

- Intra-regional transshipment. Similar to the one before but in a lower scale. The Port acts like a distribution and reception maritime center in the Occidental and Oriental Mediterranean, North and West Africa, markets which constitute the maritime hinterland of the Port, of the traffic flows coming from or going to the same region.

- Relay transshipment. The Port acts like a center of traffics with intercontinental origin/destination, as a consequence of the transoceanic lines crossing that scale in a port (interlining).

Àrea Origen/Destinació	Europa Occidental	Med. Oriental	Àfrica	Àsia	Amèrica	Oceania
Europa Occidental Mediterrani Oriental Àfrica	Intra-Regional			Hub & Spoke		
Àsia Amèrica Oceania	Hub & Spoke			Relay		

Figure 107. Types of transits from a Port depending on the transshipment operation executed (*source: Port Authority of Barcelona*)

By getting a higher leverage from any of the existing carriers, Barcelona would be able to get a bigger volume of transits. The currently existing carriers have been analyzed in order to find any chance to transfer some of their transits to Barcelona. Although in each case the amount of volume transferred is not so important, the following table shows a list of the potential catchment.

Table 174. Potential catchment of Port of Barcelona traffic from its main carriers (*source: individual*)

Port of Barcelona opportunities			
Direct scale	**Carrier / alliance**	**Feeders**	**Opportunity**
	EVERGREEN EUROPE-ASIA-AMERICA	1	✓ Hub in Taranto, where they have a joint venture terminal. ✓ Concentrate in Barcelona the distribution with feeders to North Africa and the Occidental Mediterranean (UAM Service), while keeping Taranto as a hub for the Oriental Mediterranean with Evergreen feeders.
	COSCO/KLINE/YANG MING/ HANJING EUROPE-MED-ASIA	1	✓ Hub in Piraeus, which belongs to COSCO. ✓ Distribution to the North and West

			Africa, and the Occidental Mediterranean (MD1 Service). ✓ Distribution to West Africa, currently served via Napoli and Genova.
1	HANJIN / HAPAG ASIA-MED-USA-CANADA		✓ Hub in Cagliari and Algeciras. ✓ Incorporate Barcelona as a direct scale in the JMCS Service that currently stop in other Occidental Mediterranean Ports (Valencia, Genova, Fos, Livorno, Cagliari, Algeciras).
1	HANJIN / UASC EUROPE-MED-MIDDLE EAST ASIA-USA	1	✓ Barcelona is only a scale in the importations, while Valencia (hub) is in both flows. ✓ Incorporate a scale in Barcelona in the export flow (MINA/IMU Services). ✓ Distribution from Barcelona to West Africa (instead of Valencia).
1	HAPAG LLOYD MED-GOLF	1	✓ Grand Alliance Oriental Mediterranean Sea hub: Cagliari. ✓ Distribution to Fos (currently it is served from Cagliari, MGX Service). ✓ Incorporate a scale in Barcelona in the export flow (MPS Service).
	HAPAG LLOYD / OOCL / MOL	1	✓ Distribution to North Africa (Med-Asia Service).
	UASC	1	✓ Distribution to North Africa (AMC-1/AMX1 Services).
	COSCO	2	✓ Distribution to West Africa of the Long Distance Lines with Asia of CKYH (instead of Genova and Napoli). ✓ Substitute Genova as the Occidental and Oriental Mediterranean distribution hub of the MINA/IMU Services (COSCO slot buyer).
1	HAMBURG SÜD	1	✓ Substitute Vado Ligure as the Oriental Mediterranean hub of the Sirius Service. ✓ Distribution to North Africa (Sirius

			Service). Currently there is no HAMBURG SÜD feeder from Barcelona and Valencia.

Based on this, a SWOT analysis in the strategy of transits from Barcelona is carried out below:

Strengths (internal)	**Weaknesses (internal)**
✓ Space availability and high capacity of container traffic. ✓ Terminal necessity of accomplish with traffic commitments. ✓ Possibility of changing the Port strategy with the new Moll Prat Terminal and the TCB extension.	✓ High costs in comparison with other European ports. ✓ Difficulties in the movement between terminals. ✓ Absence of public feeder lines. ✓ High concentration of transits in only a few carriers (MSC and CMA-CGM represent the 79%). ✓ Concentration of transits in carriers that use their own feeder services. ✓ Low proactive position of Port of Barcelona terminals. ✓ High stowage cost. ✓ Cost of changing quay. ✓ The terminals have a limited volume of transits above the total amount of containers handled.

Opportunities (external)	**Threatens (external)**
✓ Asian carriers are not yet completely positioned in the Mediterranean Sea. ✓ Tendency to substitute hub ports to gateway ports. ✓ High volatility of transit traffic, which facilitates the catchment of transits from other ports. ✓ Conflicts in other ports (for example, in Marseille).	✓ Barcelona is far away from the main route Suez-Gibraltar. ✓ The main carriers are already leveraged in other Occidental Mediterranean Ports. ✓ Some carriers are in different Mediterranean terminals (MSC in 5, Maersk and CMA-CGM in 4, Cosco and Grand Alliance in 3), which hinders even more new catchments. ✓ Glut of containers in the Mediterranean Sea, with prospects of extension of some competitor ports. ✓ Low cost competition due to the

	entrance of new competitors, such as Tanger Med.

The strategy of Port of Barcelona defines it as a gateway port. Due to its geographical position, far from the main route Suez-Gibraltar, it cannot be positioned as a hub port, but it needs to complement its hinterland strategy with a transits catchment strategy.

Port of Barcelona established as a strategy that Barcelona had to be a gateway port instead of a hub port for which the geographical situation is not adequate. The election of this strategy, added together with the port saturation previous to the economic crisis has had some consequences in the transit market from Barcelona:

- In the past the development of public terminals instead of carrier dedicated terminals was promoted. This means that today in Barcelona there is no carrier leverage in the Port.

- Some limits have been established to the volume of transits handled in each terminal, in order to promote the hinterland traffic and the interest in the terrestrial distribution.

- When before the European economic crisis there was saturation in the Port, the option of receiving more transits in Barcelona was rejected (especially concerning empty containers).

- All these made that the only carrier which had adopted Barcelona as a hub port (ZIM), as it did not have any leverage in the Port, moved to Tarragona in order to participate in its new terminal.

Currently, due to the extension of the terminals in Barcelona there is no capacity limitation in Port of Barcelona. In this new situation, a new strategy of promotion of transits is adequate, as long as the following principles are followed:

- Barcelona is a gateway port and the transits must be conceived as another option of modal distribution, same as road, rail and short sea shipping. Therefore, transit is conceived as a complement to origin/destination traffic instead of an objective in itself. Thus the basic mode must be the hub and spoke transit, facilitating the maritime distribution from Barcelona.

- It is convenient to get carrier leverage in the Port of Barcelona. Unfortunately it is late because almost all the carriers are already installed in the Mediterranean Sea.

- As transits represent a cost for the carriers, it is of primary importance to develop a cost reduction strategy in order to compete with other European Ports.

As a consistent proposal, after discussing with shipping companies, if they decide to open a maritime service exclusively for the Mediterranean ports there is a big chance for Barcelona. This new service would consist in stopping, for example, only in a few Mediterranean ports, such as Piraeus, Barcelona and Algeciras, and after going back to the Far-East without doing the whole round to the North European ports. The frequency of this service would be weekly and the capacity around 14.000 TEU.

In this new maritime service, thanks to the lower number of km travelled by Sea, with the same number of vessels more round-trips could be done every year. Also it would be an optimized solution for carriers to put together all the cargo to the Mediterranean Sea in a unique weekly service, enabling thus that the North European services do less stops before reaching their destination.

The key point of this Mediterranean service would be that within the three stops (as mentioned before, for example in Piraeus, Barcelona and Algeciras) all the cargo (14.000 TEU) is distributed to its destination – both in the Mediterranean Europe and in Africa –. As in Spain the consumption market is not big enough, same as in Greece, the ports involved in this service would need to improve their transshipment services.

To show how many km and how many travelling days could be saved by using this potential service, the distances from Port Said to Piraeus, Barcelona, Algeciras and Rotterdam have been calculated.

Table 175. Distances (in km and time) of the potential exclusive Mediterranean service *(source: own-source)*

Route	Distance (km)	Distance (time)
Port Said – Piraeus	1.098	2 days 11 h
Piraeus – Barcelona	2.140	4 days 20 h
Barcelona – Algeciras	960	2 days 4 h
Algeciras – Port Said	3.546	8 days 0 h
Total	**7.744 km**	**17 days 11 h**

Table 176. Distances (in km and time) of an existing service to the Northern Europe *(source: own-source)*

Route	Distance (km)	Distance (time)
Port Said – Piraeus	1.098	2 days 11 h

Piraeus – Barcelona	2.140	4 days 20 h
Barcelona – Algeciras	960	2 days 4 h
Algeciras – Rotterdam	2.140	5 days 17 h
Rotterdam – Algeciras	2.140	5 days 17 h
Algeciras – Port Said	3.546	8 days 0 h
Total	**12.024**	**28 days 21 h**

As it can be observed, more than 4.000 km and more than 11 days per maritime service could be saved by using a service exclusively to the Mediterranean Sea coming from the Far-East. The distances of Table 175 and Table 176 have been calculated starting from Port Said because the distance from the origin port in China to Port Said is the same for both services.

This reduction in the km's and time travelled could allow the usage of fewer vessels offering the same weekly frequency.

In conclusion, there is this big chance for Port of Barcelona to persuade carriers about this option. However, first the transshipment conditions offered by the port must be improved as described above. Carriers are usually only concerned about port-to-port services, and not door-to-door services. This means that they do not consider the preferences of the final customer because their unique decision variable is cost.

However, from the final customer point of view, the key variables when shipping a container are cost, time and reliability. It is obvious that knowing the exact time when a container will arrive to its destination helps to plan the production of a company. Nowadays markets are very strict and delays when shipping may handicap a lot of business successes. In order to improve this reliability, the final customer opinion is important because the location of the port of arrival can help its success. In other words, the final customer may prefer to use a specific port for reliability reasons, but carriers are only concerned about costs.

In Barcelona the hinterland is mainly Spain and the south of France. It is almost indifferent to serve the Spanish hinterland from Valencia, Barcelona or Algeciras, and to serve the South French hinterland Barcelona is the best option – Marseille also but it does not imply a big competence nowadays –. In conclusion, the location of Barcelona with respect to the final customers is more optimal than the location of other ports, so if door-to-door services were taken into account more than port-to-port services and if this Mediterranean service proposed was supported by carriers, then Barcelona would have a big chance of increasing the amount of cargo handled coming from mainland China.

Apart from these measures related to transits and the previous ones related to infrastructure and services offered, also the relations of the port with the railway operators that connect it to the hinterland are important, in order to facilitate the distribution of the cargo to its final destination. In that way, some carriers mentioned that Barcelona is an active port which is putting recently big efforts to execute improvements in this aspect, and also to increase its hinterland to the South of France.

Another important aspect that will need to be considered in the future is the alliances between carriers. There exist three different types of alliances:

- Alliances in which carriers share slots in vessels but the vessel operation is independent.

- Alliances in which carriers give some vessels to an independent company which sell slots to the different carriers operating in the alliance. This is the case of the P3 Alliance (Maersk, CMA CGM, MSC).

- Fusions and acquisitions. Recently the market is not very active in this aspect, but in the last decade it was. The biggest carriers currently existing absorbed and acquired a lot of the others.

In the future, the market will tend to be more and more consolidated in order the carriers to get more profits from sharing their vessels. This consolidation will imply, as mentioned before, the usage of bigger vessels that will force the European ports to adapt their terminals to them if they do not want to miss business opportunities. For the moment the biggest vessels expected are about 18.000 TEU capacity. Some carriers like Maersk mentioned that they do not expect to use 24.000 TEU capacity vessels in the near future, as currently there exist no market capable of absorb them.

Finally, it is important to mention the increasing importance of the social responsibility of carriers in the shipping business. As it was said before, when the commercial partner is mainland China, the highest emissions occur on the North European services, followed by the West Med, followed by the Adriatic. However, when realistic scale effects are taken into consideration, the order is reversed. If the hinterland connections were improved in Southern Europe, then a potential shift from the North to the South could be considered. However, for the moment the economies of scale and the higher load factors of the Northern ports confirms that from a sustainability point of view the shift is not optimal.

All in all, in this chapter some improvements related to ports infrastructure, customers service, hinterland connections, transit policies and others has been suggested, and focused on the Port of Barcelona. These improvements will contribute to the optimization of the performance of

European Mediterranean ports in the near future, and specially will be profitable for Barcelona if applied.

In that sense, in the previous years Barcelona has proven its conviction of investing in improving its infrastructure. Some years ago it started to operate a new terminal: Barcelona Europe South Terminal (BEST). It is the first semi-automated terminal in the HPH Group and the most technologically advanced port development project in Spain. It is capable of serving multiple mega-vessels simultaneously and has an eight-track railway facility, the biggest on-dock railway terminal of any port in the Mediterranean connecting it to traffic coming from, and destined for, Southern Europe.

When building this new container terminal, Port of Barcelona also had to plan the construction of the new accesses to it. The road accesses project was therefore part of the project of the New Containers Terminal of the Barcelona Port. The new roads allow the access to the Tercat Terminal. Two road junctions, connected through the Prat Road, were designed. The section was formed by a rail yard that provided service to the Tercat Terminal and a 3+3 rail axis and a rail service branch line for Decathlon.

The complexity of this project was the execution of the different phases of the road and rail layout, taking into account the structures that had to be designed to serve the containers terminal of the Barcelona Port.

Due to the construction of the new accesses to the South Extension of Port of Barcelona, there arose the necessity of including actions that, although they were out of the strict geographical area of the new accesses, influenced importantly the right operation of the infrastructures defined.

One of these actions was the reshuffle of the existing intersection between L’Estany del Port Avenue, Street 100 and Street 114, as they were part of the natural itinerary of arrival to the South Extension of Port of Barcelona, in Prat del Llobregat municipality. All the constructive actions carried out in the affected area related to this construction project will be described in part 2.

5. Conclusions

This research is about the logistics services in the containerized export flows from mainland China to Europe. The main purpose of it was to analyse and model the current container flows from mainland China to Europe through the definition of key variables, their future changes and the optimisation measures to be adopted by Port of Barcelona in order to adapt to the new scenario. The research was complemented by the execution of interviews to the principal carriers currently operating maritime services from mainland China to the Mediterranean Europe.

Based on an intensive analysis using data from Eurostat, European Port Authorities and other reliable sources of information, the current container flows from mainland China to a selected group of 23 European ports were drawn taking into account the rate of empty containers, the percentage of cargo transhipped and the usage of inland waterways.

Approximately 75% of containerized cargo shipped from mainland China to Europe goes to the Northern range of European ports (approximately 5.300.000 TEU in 2012), 25% going to the Mediterranean (approx. 2.000.000 TEU in 2012). Among the Mediterranean Sea the main importers of loaded containers coming from mainland China are Valencia (420.026 TEU in 2012), Marseille (204.427 TEU in 2012), Tanger MED (190.000 TEU in 2012), Barcelona (185.291 TEU in 2013), Algeciras (158.880 TEU in 2012), La Spezia (119.180 TEU in 2013), Genova (87.778 TEU in 2012), Gioia Tauro (11.043 TEU in 2012) and Malta (6.528 TEU in 2012).

However, big differences are encountered between hub ports, gateway ports and mixed ports. Hub ports are those with a poor demand from their hinterland consumption market and a high rate of transhipment, while gateway ports are the opposite. In the Mediterranean Sea, hub ports are Malta, Gioia Tauro, Algeciras and Valencia with a rate of transhipment of 96, 95, 87 and 38%, respectively; while gateway ports are Marseille, La Spezia, Genova and Barcelona with a rate of transhipment of 4, 5, 13 and 17%, respectively. Ports of Barcelona, Valencia and Genova could be considered as mixed ports because they combine effectively the hinterland distribution and the feeder maritime services.

In order to investigate which are the main variables defining the current container flows from mainland China to Europe, it was necessary to understand carriers' operation procedures.

Although the Southern European ports present advantages in terms of costs with respect to the Northern European ports, the fact that the hinterland market demand is in the North of Europe implies that economies of scale and load factors reverse the situation and makes the North election cheaper for carriers. Similar conclusions can be extracted referring to the carbon emissions.

Interviews to the main carriers operating between mainland China and the European Mediterranean ports were carried out. The aim of these interviews was to identify which are the main priorities of shipping companies in the exportation from China to Europe, the future changes that they will introduce in their vessels, the future potential alliances between them and their intentions of investing in some Mediterranean Ports. The interviews were targeted to the 18 carriers currently operating from mainland China to Europe.

Difficulties were encountered in this part when contacting carriers based in China for executing the intended interviews. Sensitive information required and confidentiality policies were the main reasons for meeting such complications. Finally 8 out of the 18 carriers were interviewed. The most important conclusions extracted from the interviews to carriers are summarised here.

First, all the maritime services offered by carriers have a significant rate of transhipment that is lower or higher as a function of the operating ports. Most of the carriers do not have their own feeder services in the European Mediterranean ports; normally they use common feeders. This fact contrasts with Port of Barcelona, where 92% of transits are fed up by dedicated feeder networks, and only an 8% of transits are covered by public feeders.

No big changes are expected in the current feeder networks in the Mediterranean Europe for the future. With other parts of the World, especially with Africa, there will be a lot of changes in the shipping industry. The number of shipping services between mainland China and Africa will increase a lot in the next years.

In addition, carriers will introduce bigger vessels of 18.000 TEU capacity in their fleet (CSCL and Maersk). However, they will only operate in the Northern Europe. Some other carriers state that the 16.000 TEU capacity vessel is the biggest they will introduce (MSC, CMA CGM), and some others have enough with 14.000 TEU capacity vessels NYK, COSCO).

After a deep research, the European Mediterranean ports capable of adapting to these new vessels are: Barcelona, Valencia, Algeciras, Tanger MED, Malta, Gioia Tauro, Genova (Voltri) and Marseille Fos (2XL). Other ports such as Cagliari, La Spezia and some terminals in Marseille Fos and Genova are not ready to receive such big vessels.

To sum up, in the near future the Mediterranean ports should focus their efforts in the following three measures:

- To reduce their operational costs. Nowadays these costs are mainly labor costs related to the stevedoring companies.

- To improve their agility in terms of loading and unloading cargo and their communication facilities with the carriers. Here it must be said that normally is not the port but the customs office who should improve these services.

- To adapt their infrastructure to the new 18.000 TEU capacity vessels.

And in order to get higher market shares these three measures should be improved when related to transshipment cargo. The local cargo is not as volatile as the transshipment cargo because there are fewer options when choosing a gateway port for a specific area.

In the particular case of Port of Barcelona, a new strategy of promotion of transits would be adequate as long as the following principles are followed:

- Barcelona is a gateway port and the transits must be conceived as another option of modal distribution, same as road, rail and short sea shipping. Therefore, transit is conceived as a complement to origin/destination traffic instead of an objective in itself. Thus the basic mode must be the hub and spoke transit, facilitating the maritime distribution from Barcelona.

- It is convenient to get carrier leverage in the Port of Barcelona.

- As transits represent a cost for the carriers, it is of primary importance to develop a cost reduction strategy in order to compete with other European Ports.

As a consistent proposal, after discussing with shipping companies, if they decide to open a maritime service exclusively for the Mediterranean ports there is a big chance for Barcelona. This new service would consist in stopping, for example, only in a few Mediterranean ports, such as Piraeus, Barcelona and Algeciras, and after going back to the Far-East without doing the whole round to the North European ports. The key point of this Mediterranean service would be that within the three stops (as mentioned before, for example in Piraeus, Barcelona and Algeciras) all the cargo (14.000 TEU) is distributed to its destination. The frequency of this service would be weekly and the capacity around 14.000 TEU. More than 4.000 km and more than 11 days per maritime service could be saved by using a service exclusively to the Mediterranean Sea coming from the Far-East. This reduction in the km's and time travelled could allow the usage of fewer vessels offering the same weekly frequency.

In conclusion, although in the near future no big changes are expected in the Mediterranean Sea, the development of good strategies about transshipment operations, the technical improvement of terminals and the reduction of operational costs can make Port of Barcelona increase its market share in the Far East – Europe maritime trade.

6. References

Adalmir, J. de Souza; Juan Martín Mallofre; Ricard Marí Sagarra (UPC Editions): “El transporte de contenedores: terminales, operatividad y casuística”.

Ministerio de Fomento. “Anuario estadístico de puertos. 2012”.

Shibasaki, Ryuichi; Shishido, Tatsuyuki; Suzuki, Masaru (2014): “Intermodal freight simulation in Southern Mekong Region: Route Model for International Container Shipping”.

Turró, Mateu: “L’Euram, porta d’Europa. Reflexions a partir del Llibre Blanc de les Infraestructures de l’Euram”.

Shibasaki, Ryuchi; Azuma, Toshio; Watanabe, Tomihiro; Toriumi, Shigeki (2013): “A container cargo assignment model on a real international maritime shipping network and application to the Suez Canal transit analysis”.

Anonymus; IAME 2014 Conference Norfolk VA USA: “Integrated model of maritime and hinterland container shipping considering both freight and shipping time and application to Central America”.

Adarve i Panicot, Pol (2010): “Complementarietats dels ports de València i Barcelona. Anàlisis de les possibles millores de la connexió (carretera, ferrocarril short sea shipping) entre els dos ports per potenciar-les”.

Garcia-Milà, Santiago (2011): “Los puertos como facilitadores de la cadena logística: ejemplos del Port de Barcelona”.

Port of Barcelona Chair of Logistics, CEIBS (2011): “Value proposition of each agent in the supply chain”.

Port of Barcelona Chair of Logistics, CEIBS (2008): “Direct-to-store distribution impact on European Ports. Final report”.

Suffolk Coastal District Council (2008): “Felixstowe Port Logistics Study. Draft Final Report”.

Bremenports GmbH and Co. KG (2012): “Facts and figures. The ports of Bremen”.

Port of Antwerp (2011): “The port of Antwerp in figures”.

Landa, Dominik (2012): “Positioning DCT Gdansk at the doorstep of strongest European growth”.

Port of Rotterdam (2012): “Port statistics (2010, 2011, 2012)”.

Eurostat (2013): “Key figures on Europe. 2013 digest of the online Eurostat yearbook”.

Eurostat (2013): “Eurostat regional yearbook 2013”.

Eurostat (2013): “Energy, transport and environment indicators”.

Watson, Andrew (2014): “HM Revenue and Customs. Regional Trade Statistics. Fourth Quarter 2013”.

Branch, A. (1996): “Elements of shipping”. 7th edition. London: Chapman & Hall.

Broeze, F. (2002): “The globalization of the oceans: Containerisation from the 1950s to the present”. St. Johns, NF, Canada: International Maritime Economic History Association.

Cudahy, B. J. (2006): “The container revolution. Malcolm McLean’s 1956 innovation goes global”. TR News 246, 5-9.

http://www.portdebarcelona.cat/en/

http://www.valenciaport.com/es-ES/Paginas/default_es_ES.aspx

http://www.portofalgeciras.com/

http://www.bilbaoport.es/aPBW/web/es/index.jsp

http://www.portofrotterdam.com/en/Pages/default.aspx

http://www.hafen-hamburg.de/en

http://www.portofantwerp.com/language

http://www.portoffelixstowe.co.uk/

http://www.bremenports.de/

http://www.haropaports.com/fr/le-havre

http://www.southamptonvts.co.uk/

http://www.mardas.com.tr/Acentelik/mardas.aspx?id=25&lang=en

http://www.olp.gr/en/

http://www.marseille-port.fr/fr/Accueil/

http://www.tmpa.ma/

http://www.zeebruggeport.be/

http://www.portgdansk.pl/en

http://www.porto.laspezia.it/it

http://www.portodesines.pt/

http://www.porto.genova.it/

http://www.portodigioiatauro.it/index.php

http://www.maltafreeport.com.mt/

http://www.porto.cagliari.it/

http://www.academia.edu/4285313/Merchant_Marine_and_Maritime_Transport_in_Spain_2012-2013

http://www.maerskline.com/link/?page=brochure&path=/our_services/built_for_the_future

Annex nº1. Country abbreviations

BE: Belgium

BG: Bulgaria

CZ: Czech Republic

DK: Denmark

DE: Germany

EE: Estonia

IE: Ireland

EL: Greece

ES: Spain

FR: France

HR: Croatia

IT: Italia

CY: Cyprus

LV: Latvia

LT: Lithuania

LU: Luxembourg

HU: Hungary

MT: Malta

NL: Netherlands

AT: Austria

PL: Poland

PT: Portugal

RO: Romania

SI: Slovenia

SK: Slovakia

FI: Finland

SE: Sweden

UK: United Kingdom

IS: Iceland

LI: Liechtenstein

NO: Norway

CH: Switzerland

MK: Former Yugoslav Republic

TR: Turkey

Annex nº2. Interview questions to carriers

The company 公司

The objective is to categorize the questionnaire's conclusions by size and type of enterprise.

<table>
<tr><td>Company name
公司名称</td><td colspan="3"></td></tr>
<tr><td>Member of any shipping alliance
海运联盟企业</td><td colspan="3">Name of the alliance 海运联盟名称:

Members of the alliance 海运联盟成员:</td></tr>
<tr><td>Interviewee name
受访人</td><td></td><td>Position
职位</td><td></td></tr>
<tr><td>Contact information
联系方式</td><td>E-mail:
邮件</td><td colspan="2">Phone:
电话</td></tr>
<tr><td>Country of origin
原产国</td><td colspan="3"></td></tr>
<tr><td>Headquarters
总部</td><td colspan="3"></td></tr>
<tr><td>Company size
企业规模</td><td>Revenues:
年收入</td><td colspan="2">Number of employees:
员工人数</td></tr>
<tr><td>Subsidiaries and offices
分支机构</td><td colspan="3"></td></tr>
<tr><td>Location in China
中国地址</td><td colspan="3">Offices:办公室地址</td></tr>
<tr><td>Legal status in China
企业性质</td><td colspan="3">☐ WFOE (Wholly Foreign Own Enterprise)外商独资
☐ Joint venture 合资
☐ Representation office 代表处
☐ Working through Chinese partner 中国合作伙伴
☐ No legal structure in mainland China 中国大陆未注册公司
☐ Chinese private firm 私营企业
☐ Chinese SOE 国企</td></tr>
</table>

The company's current situation in the transport of TEU from mainland China to Europe 从中国大陆到欧洲的标准箱运输的现状

1. How many loaded TEU did you ship in 2013 from China to Europe? 你在 2013 年从中国运到欧洲总共的标准箱数量？

2. How many loaded TEU did you ship in 2013 from China to the following
3. ? 你在 2013 年从中国运到以下地中海港口总共的标准箱数量？

Port 港口	**Number of loaded TEU exported from China to each Port by your shipping company, 2013** 2013 年从中国运到各港口标准箱的数量	**Tonnes of goods exported in containers from China to each port by your shipping company, 2013** 2013 年从中国运到各港口标准箱的吨数
Barcelona 巴塞罗那		
Malta 马耳他		
Genova 热那亚		
Gioia Tauro 焦亚陶罗		
Fos 福斯		
Cagliari 卡利亚里		
Valencia 瓦伦西亚		
Tanger MED 丹吉尔		
Algeciras 阿尔赫西拉斯		

4. How many maritime services do you offer from China to the European Mediterranean ports? 您提供从中国到欧洲的地中海港口的多少种海运服务？

Maritime service 海事服务	**Alliance** 联盟	**Carrier*** 船东	**Capacity (TEU)** 容量（TEU）	**Frequency** 频率	**Rotation (calls of the route)** 轮班	**Number of ships of the maritime service** 航运服务

						船舶的数量

* Refers to the member of the Alliance who owns the vessel of the maritime service. In case this ownership takes turns among the members of the alliance, specify it.

5. Do you have <u>leverage</u> in any Mediterranean European Port? Which one?
你有没有利用任何欧洲地中海港口做平衡？哪一个？

6. Which are your main operating ports in China, and what is the percentage of TEU loaded in each of them and transported to the European Mediterranean ports among the total number of TEU shipped with your company from China to the European Mediterranean ports? 哪些是你在中国的主要经营的港口，每个港口占运往地中海港口TEU 总量的百分比是多少？

1- ______________________________, ______%
2- ______________________________, ______%
3- ______________________________, ______%

4- ______________________, ______%
5- ______________________, ______%
6- ______________________, ______%
7- ______________________, ______%
8- ______________________, ______%
9- ______________________, ______%
10- ______________________, ______%

7. What are your decision criteria when choosing your **TRANSHIPMENT PORT** in Europe? Punctuate the following options from 1 (less important) to 10 (most important):你在选择欧洲转运港的决定性因素是什么？请打分 1（代表不重要）10（最重要）

Decision variable **影响因素**	**Punctuation (1 to 10)打分（1-10）**	**Comments** **评价**
Proximity to the final hinterland destination 接近最终的目标腹地		
Leverage in the Port 港口的杠杆效应		
Alliance (the decision is conditioned by the alliance membership) 联盟（该决定是由该联盟成员决定）		
Services and facilities in the terminal 服务和设施		
Sea distance from the origin to the Port 始发地距离港口的距离		
Port call and berth requests 停靠泊位的要求		
Port taxes (Port Authority taxes) 港口税（港务局税）		
Port taxes (terminal taxes) 港口税（码头税）		
Degree of saturation (rate of usage of the Port) 饱和度（港口的使用率）		
Technical condition of the terminal 港口技术条件		

Door-to-door cargo influence in the Port 在港货物门对门服务的影响		
Communication / customer service / language 交流，客户服务，语言		
Good transit policies (customs declaration, inspections, etc.) 良好的运输政策（（报关，商检等））		
E-commerce: Shipment instructions 电子商务：出货说明		
E-commerce: Tracking 电子商务：跟踪		
E-commerce: Invoicing and payment 电子商务：发票和付款		
Green logistics chain 绿色物流链		
Othe 其他 ………………………………… …………………………………………...		

8. If offering door-to-door maritime services, which of the following services add more value or are more important for your company at the destination port? Punctuate the following options from 1 (less important) to 10 (most important):若提供门到门服务，以下哪些服务为您公司在目的港的业务加分？请打分 1（代表不重要）10（最重要）

Service **服务**	**Quality at destination port 目的港的质量**	**Comments 评价**
Rail/road facilities/services 铁路/公路设施/服务		
Delivery pick up pre alert 交货提前预警		
Gate in/out notifications 进/出 港通知		
Trucks identification 卡车身份识别		

Train loading/unloading 火车装载/卸载		

9. Which services could be improved?哪些服务需要改进

Port **港口**	**Service to improve** **需要改进的服务**	**Improvement description** **具体改进描述**
Barcelona 巴塞罗那港		
Malta 马耳他港		
Genova 日内瓦港		
Gioia Tauro 焦亚陶罗港		
Fos 福斯港		

Cagliari 卡利亚里港		
Valencia 瓦伦西亚港		
Tanger MED 丹吉尔港		
Algeciras 阿尔赫西拉斯港		

10. Which of the following two options do you prefer when shipping from China to Europe?
下列哪两个从中国到欧洲航运的选项你更喜欢

☐ Concentration of big volumes in traffics with a lower number of scales, feeding later other ports by feeder services. 专注运输量大的，支线运输

☐ Traffics with a higher number of scales, reducing transit operations. 航运密集度高，减少转运操作

11. Which type of Port do you prefer for your **TRANSHIPMENT SERVICES**:
哪种港口的转运服务你更喜欢

☐ Hub (transshipment to transoceanic route + hub and spoke).
枢纽（转运到跨洋航线+枢纽辐射式航线结构）

☐ Gateway (hub and spoke). 出货港（枢纽辐射式航线结构）

12. Do you have your own feeder services in the Mediterranean Europe Ports?

你有自己到地中海港口的支线运输的业务吗？

☐ Yes. 是

☐ No. 否

13. If yes, name them:若有，请指出

Feeder service 支线运输	**Origin Port (Mediterranean Sea)**出货港（地中海）	**Destination Port (Mediterranean Sea)** 目的港（地中海）	**Capacity (TEUs)** 标准箱量	**Frequency** 频率

14. How many loaded TEU shipped from China to the following Ports in the Mediterranean Sea are after transhipped to another Port? 从中国到地中海的下列港口转运到另一个港口的标准箱的总量？

Port 港口	**Number of loaded TEU from China to the Port and transhipped by a feeder service** 从中国到支线运输航线标准箱总量	**Number of loaded TEU from China to the Port and transhipped by a transoceanic service** 中国到跨洋航线标准箱总量	**Main port destinations of these transhipments** 转运的主要目的地港口

Barcelona 巴塞罗那港			
Malta 马耳他港			
Genova 日内瓦港			
Gioia Tauro 焦亚陶罗港			
Fos 福斯港			
Cagliari 卡利亚里港			
Valencia 瓦伦西亚港			
Tanger MED 丹吉尔港			
Algeciras 阿尔赫西拉斯港			

Future changes 未来的变化

15. What are the main technical changes that you will introduce in your fleet (changes in **capacity, length, weight**, etc.)你会引进哪些主要的技术变化（容量，长度，重量等）

CHANGES IN VESSELS CAPACITY 改变船的容量

New capacity (TEU) 新的容量（标准箱）	**Expecting date of application** 预计应用日期	**Maritime route affected** 受益的航线	**New frequency / number of ships operating the route** 航线上运营的频率

CHANGES IN VESSELS LENGTH 改变船的长度

New length (m) 新长度（米）	**Expecting date of application** 预计应用日期	**Maritime route affected** 受益的航线

OTHER CHANGES 其他改变

Description of the change 对改变的描述	**Expecting date of application** 预计应用日期	**Maritime route affected** 受益的航线	**Comments** 评价

16. Will you extend the services offered by your shipping company or by your alliance in the near future? 您会在将来扩展由您的运输公司或联盟提供的服务吗？

Maritime service 海事服务	**Current rotation (calls of the route)** 现在的轮班	**Future rotation (if changing)** 未来的轮班（若有变化）	**New capacity and frequency (if changing)** 新的容量和频率（若有变化）	**Expected date** 预期日期

17. Will you constitute an alliance with other shipping companies in the near future?
你将构会与其他船公司构成联盟吗？

Name of the alliance 联盟名称	**Shipping companies forming the alliance** 船公司成员	**Expected date of constitution** 预期结盟日期	**Future operating maritime routes** 未来执行的航线	**Capacity and frequency of the future routes** 新的运输量和频率

18. Will you increase your leverage in any Mediterranean Europe Port by any of the following procedures? Specify which Port in each case.以下哪些选项是你会增加或加强公司在地中海港口的运营项目，请指出具体港口和增加的项目

☐ Acquisition of the terminal. Port:…………………………………………………………………..
购买码头。 港口：

☐ Joint Venture. Port:………………………………………………………………………………...
开办合资企业。码头：

☐ Agreements. Specify the details and Port: ……………………………….....................
达成协议。请阐述码头和具体协议：

☐ Others:……………………………………………………………………………………........
其他

19. What are your plans with respect to the imports in transit coming from China to the European Mediterranean ports? 你对从中国出口到地中海港口的转运有什么计划？

☐ Increase the hub and spoke maritime services.增加出货港口的服务

☐ Increase the door-to-door service.增加门到门的服务

☐ Increase the transits to transoceanic routes.增加跨洋航线的数量

Please write down three more and give us your comments:请给出其他三条计划

1……………………………………………………………………………………………......

2……………………………………………………………………………………………......

3……………………………………………………………………………………………......

Annex nº3. Interview results

Shipping company 1: Mediterranean Shipping Company – Michael Zhang

The following information was extracted after an interview with Michael Zhang, a Sales Executive at MSC in charge of the Far-East to Europe lines.

Among the maritime services from mainland China to the Mediterranean Europe, Shipping Company 1 (MSC) only has direct calls at Barcelona, Genova, Gioia Tauro, Marseille Fos, La Spezia and Valencia. The rest of the Mediterranean European Ports can be reached, however, by feeder services. In the last year, in average MSC sent 500 TEU weekly from mainland China to Barcelona, 500 to Valencia, 200 to Genova, 200 to Gioia Tauro, 100 to La Spezia and 100 to Fos.

Concerning the origin of the containers coming from mainland China, MSC operates in the following Chinese Ports: Shanghai, Dalian, Qingdao, Xingang, Ningbo, Shenzhen (Shekou) and Chiwan. In the last year, in average MSC loaded 5.000-6.000 TEU weekly in Shanghai to send them to Europe, 2.500-3.000 in Dalian, 5.000-6.000 in Qingdao, 5.000-6.000 in Xingang, 5.000-6.000 in Ningbo, 2.000-3.000 in Shekou and none in Chiwan. Chiwan is used as a transhipment port for the maritime services from mainland China to Europe.

Some of the maritime services that MSC offers from mainland China to Europe are in a vessel shared with another shipping company. For example, from the Port of Shanghai MSC operates 4 vessels: 2 of them are owned by MSC, while the other 2 are shared with CMA CMG.

Concerning the transhipment rate once in Europe, approximately 50% of the containers loaded in Shanghai (2.500-3.000) that go to Europe are transhipped in the European Port. This percentage is similar for Ningbo (2.500-3.000 TEU transhipped in Europe), 25% for Xingang and Qingdao (1.250-1.500 TEU transhipped in Europe) and around 15% for Dalian (400-500 TEU transhipped in Europe).

When considering the maritime transport of goods from mainland China, it is important to consider the Chinese New Year period, during which the activity in China stops so therefore the exports from the country decrease significantly. To plan is very important and what shipping companies do is to export larger amounts of goods just before CNY, in order to prevent lack of stocks during the Festival. For MSC, in 2014 the lack season has been especially hard, as it needed more than one month to recover from the decrease in the export of containers from mainland China. In 2013, for example, it only needed 2 weeks to recover from it.

It is also important to consider the type of commodity exported from each Chinese Port, because depending on which kind of cargo is transported the TEU weight would be higher or lower. For example, concerning MSC the type of cargo exported from Qingdao and Xingang is heavy cargo (machines, electronics, etc.), also the cargo that comes from Chongqing and other inland cities in China that are transported through Yangtze river to Shanghai, and then loaded into a mother vessel, is heavy cargo. In all these cases the average TEU weight will be higher, and this is a factor to be taken into account when considering the amount of TEU transported.

MSC has leverage in two Mediterranean European ports: Valencia and Napoli.

Concerning the decision criteria when choosing its transhipment port in Europe, MSC gives the following punctuations from 1 (less important) to 10 (most important):

Decision variable	**Punctuation (1 to 10)**	**Comments**
Proximity to the final hinterland destination	9	It is important because in the Chinese part, for example, in the particular case of Shanghai, there are 2 ports: Yanshan and Waigaoqiao, and the customer has to pick up the empty container from the terminal. Then, although the terminal of Yanshang is well prepared, it may be very expensive for the customer to pick up the empty container from there (around 100-150 US Dollars per container).
Leverage in the Port	10	For them it is very important to have some leverage in the Port because then they can save a lot of money from the Port taxes.
Alliance (the decision is conditioned by the alliance membership)	5	
Services and facilities in the terminal	8	
Sea distance from the origin to the Port	8	

Port call and berth requests	8	
Port taxes (Port Authority taxes)	10	
Port taxes (terminal taxes)	10	
Degree of saturation (rate of usage of the Port)	10	
Technical condition of the terminal	8	
Door-to-door cargo influence in the Port	NO	MSC does not offer this service. However, it can be arranged by the local service if required.
Communication / customer service / language	8	
Good transit policies (customs declaration, inspections, etc.)	6	
E-commerce: Shipment instructions	5	Concerning all the e-commerce services, the policy of MSC is to share only the basic information in Internet. This is because if the client can find everything in Internet, then he or she will not call MSC to solve his or her doubts. For example, concerning the tracking concept, information about a container one day is not available until the day after, so the information is delayed in Internet.
E-commerce: Tracking	5	
E-commerce: Invoicing and payment	5	

Green logistics chain	8	
Other: ………………………………… ……………………………………………...		

Concerning the services that can be improved in the operation ports of MSC in Europe, the interviewee suggested the following:

Port	**Service to improve**	**Improvement description**
Barcelona	Congestion	For MSC it is hard to call at Barcelona Port. Sometimes they have had to wait outside the Port for one day or more. However, seems that now the situation in Barcelona is better because the volume handled there has been significantly reduced.
Genova		
Gioia Tauro		

Fos	Labour conditions	It has been noticed that in Fos there are a lot of problems concerning the labour conditions, which implies that a large number of working days the Port is not operating properly. For MSC, this is an important issue because they are in Shanghai and cannot do anything about it.
Valencia	Congestion	In the past years Valencia has been a busy port, which implies that a sudden unexpected increasing demand will not be processed in time because of the high degree of saturation of Valencia. However, for MSC seems that now the situation in Valencia is better because the volume handled there has been significantly reduced.

Genova is not one of the main operating ports for MSC. Napoli yes, but only for transit services.

There is a new alliance, named P3, which will start operating in the end of June or beginning of July 2014. The members of the P3 alliance are Maersk, MSC and CMA CGM. This alliance has already been approved by the Chinese and the American Governments, and implies that the three major shipping companies will work together in the traffic from the Far-East to Europe and to the US and Europe to the US. The three companies constituting the alliance will arrange vessels in the P3 group. The vessel operation will be carried out from London, where there will be an office only for the P3 alliance.

MSC has also alliances with other shipping companies, such as Hapag-Lloyd and CSAV. In the traffic from mainland China to Europe, for example, the alliance of MSC with CMA CGM implies vbthat both companies arrange 2 vessels respectively, and they share the space in the total 4 vessels.

MSC does have its own feeder services in the European Mediterranean ports. In average, these feeder services have capacity 1.000-2.000 TEU, the bigger ones at most 3.000-4.000 TEU. The frequency of these feeder services is at least two times a week, while the truck service frequency is daily.

The ports where MSC calls directly are the ones mentioned before: Barcelona, Genova, Gioia Tauro, Fos, La Spezia and Valencia. For these ports no feeder services are required. For the transit services, feeder vessels are employed. One of the main destinations of the MSC feeder services is in North Europe, especially in England. Therefore, it is common that a mother vessel of 10.000 TEU capacity unloads half of the cargo in Barcelona, and the second half is sent by a feeder service to England, where after it is sent by truck to a container yard where the client picks it up. As said before, MSC does not offer door-to-door services.

The following are the feeder destinations from the main Southern European Ports connected directly with mainland China. The routes of these feeder services can be seen in Figure 108 to Figure 120:

- Valencia: Casablanca (2 days), Oran (2 days), Bejaia (2 days), Skikda (2 days), Annaba (5 days), Cadiz (2 days), Sines (3 days), Leixoes (5 days), Vigo (6 days), Alicante (1 day), Malaga (1 day), Cartagena (1 day), Tarragona (1 day), Santa Cruz de Tenerife (5 days) and Las Palmas (2 days).

- Barcelona: Algers (1 day) and Port Said (4 days).

- Sines: Leixoes (1 day), Vigo (2 days), Gijon (2 days) and Bilbao (4 days).

- Gioia Tauro: Khoms (3 days), Tripoli (3 days), Benghazi (6 days), Misurata (5 days), Tunis (1 day), Rijeka (3 days), Ploce (7 days), Bar (5 days), Durres (1 day), Bari (1 day), Venice (6 days), Ashdod (2 days), Haifa (4 days), Leghorn/Livorno (1 day), Palermo (8 days), Naples (1 day) and Civitavecchia (2 days).

- Piraeus: Genova (2 days), Venice (3 days), Koper (4 days), Ravenna (6 days), Ancona (6 days), Trieste (2 days), Thessaloniki (1 day), Volos (3 days), Heraklion (1 day), Aliaga (2 days), Gebze (3 days), Gemlik (3 days) and Constanta (2 days).

- Ambarli: Odessa (1 day), Illychevsk (3 days), Burgas (1 day), Varna (3 days), Poti (3 days), Batumi (2 days), Novorossiysk (2 days), Trabzon (4 days) and Samsun (6 days).
- Beirut: Lattakia (1 day) and Alexandria (3 days).

Figure 108. Feeder services offered by MSC from Valencia (I) (*source: MSC*)

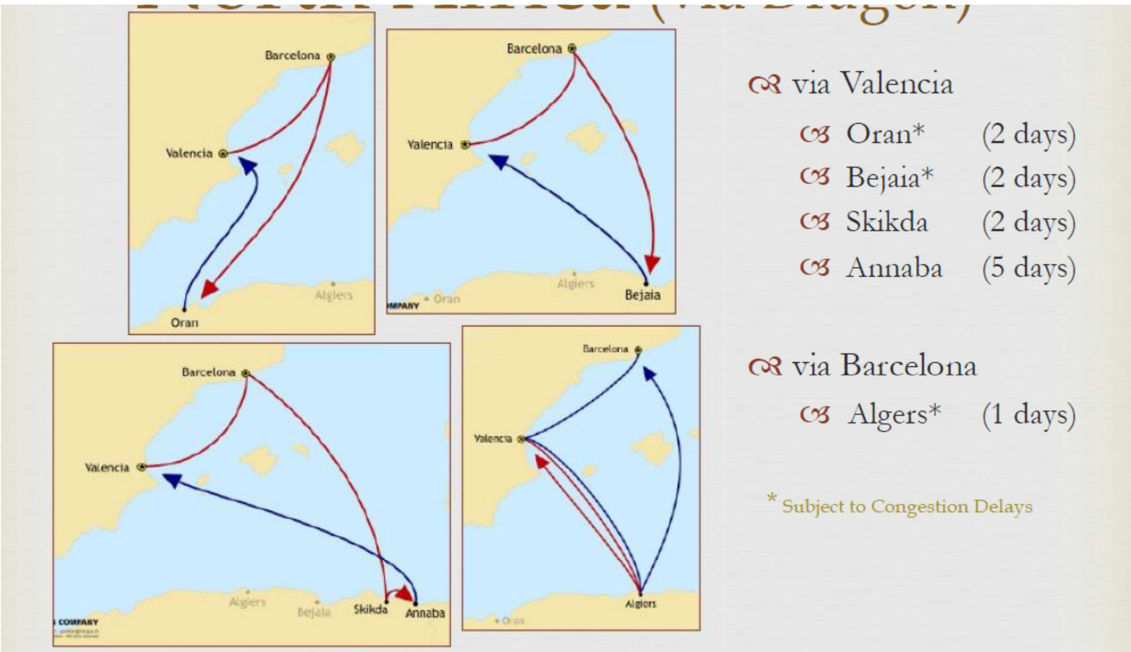


Figure 109. Feeder services offered by MSC from Valencia (II) and from Barcelona (I) (*source: MSC*)

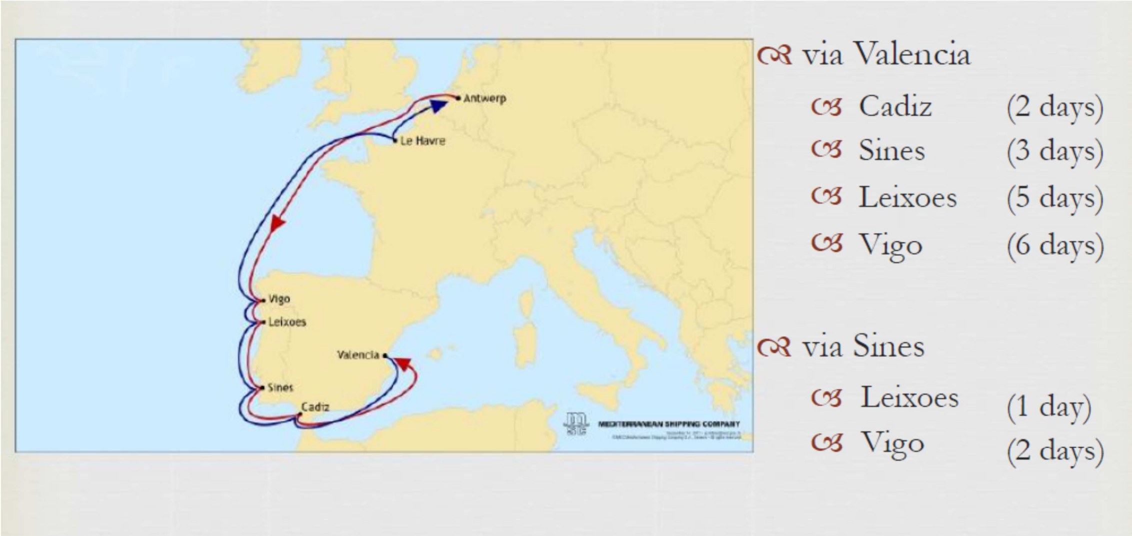


Figure 110. Feeder services offered by MSC from Valencia (III) and from Sines (I) (*source: MSC*)

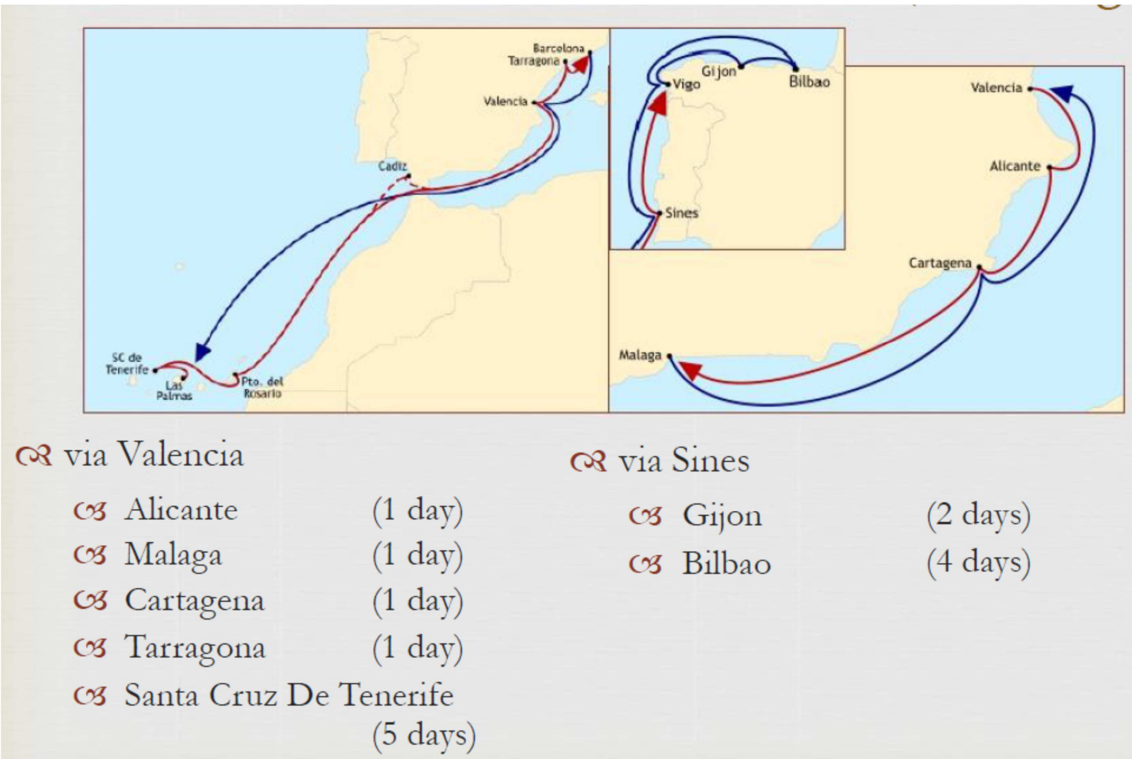


Figure 111. Feeder services offered by MSC from Valencia (IV) and from Sines (II) (*source: MSC*)

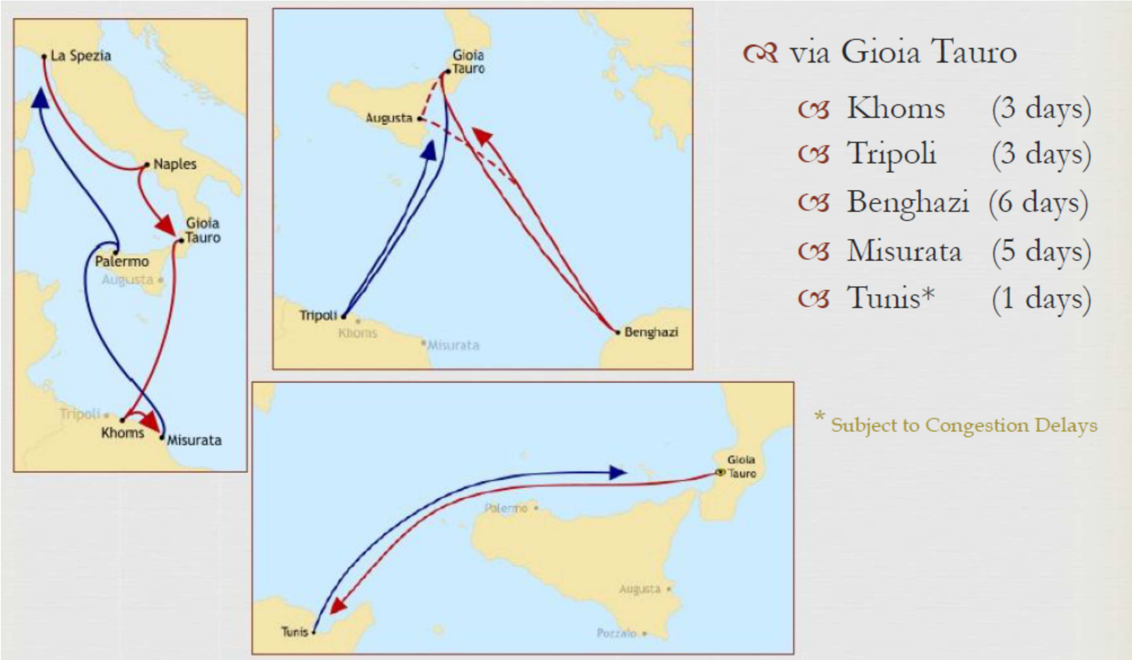


Figure 112. Feeder services offered by MSC from Gioia Tauro (I) (*source: MSC*)

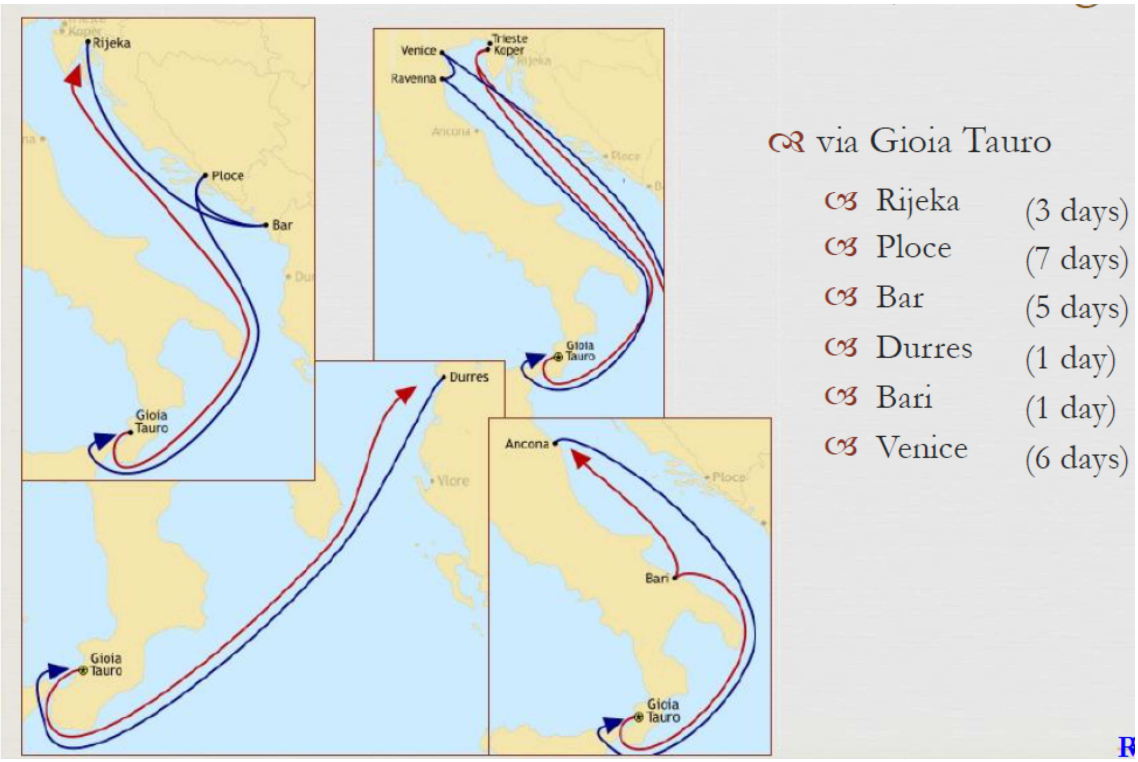


Figure 113. Feeder services offered by MSC from Gioia Tauro (II) (*source: MSC*)

Figure 114. Feeder services offered by MSC from Gioia Tauro (III) (*source: MSC*)

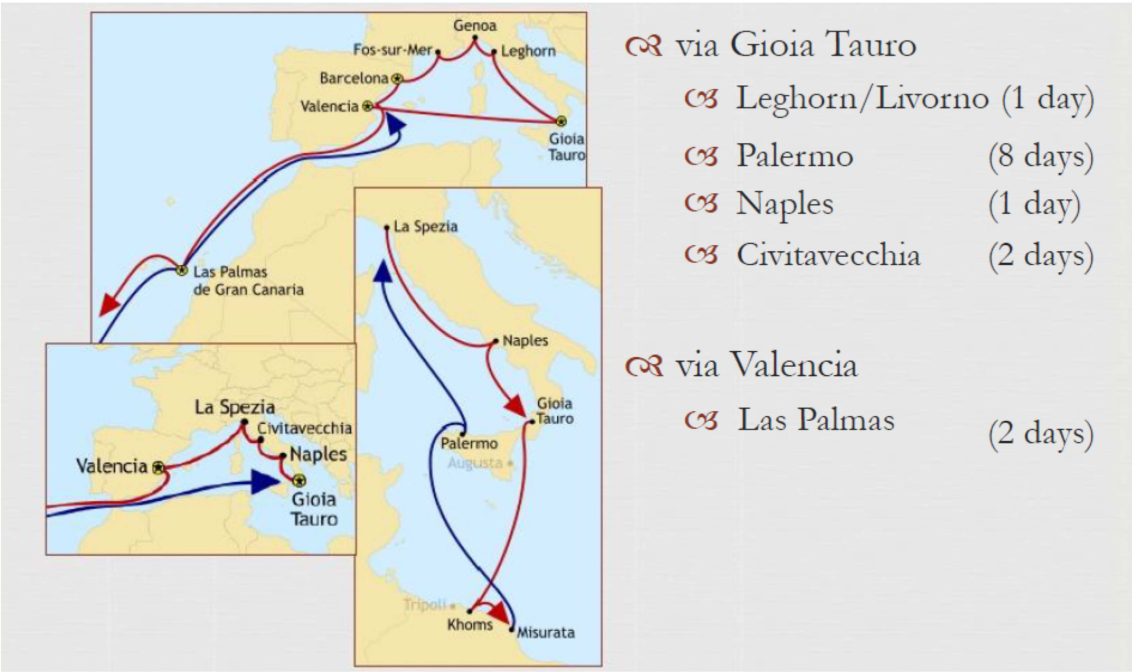


Figure 115. Feeder services offered by MSC from Gioia Tauro (IV) and from Valencia (V) (*source: MSC*)

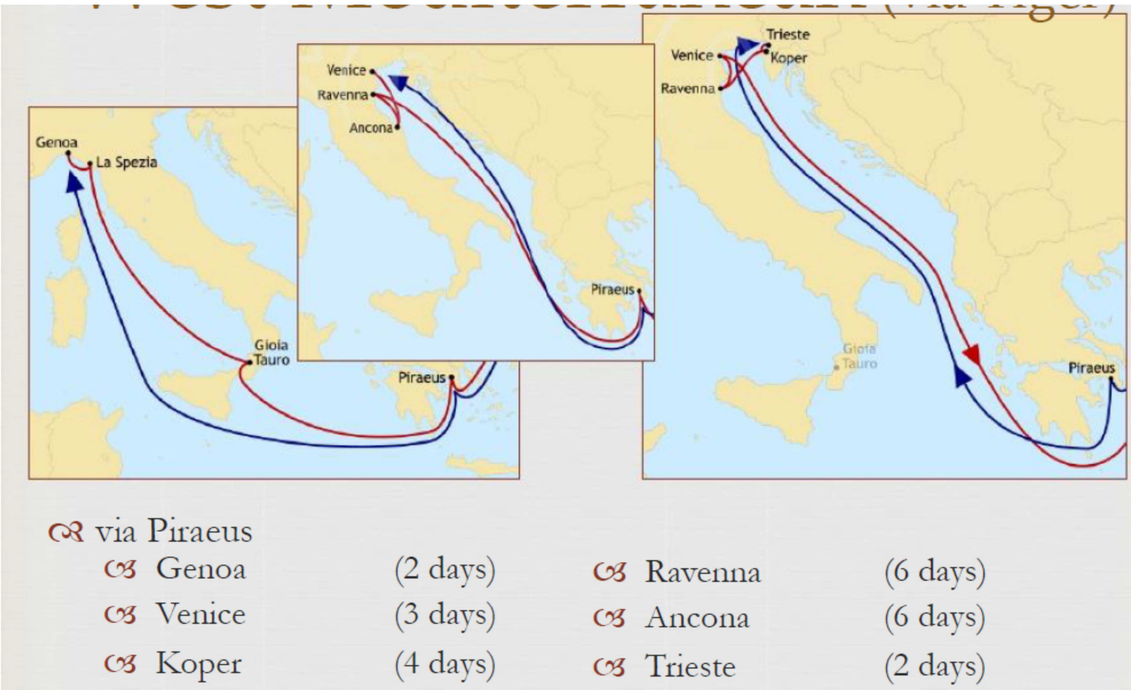


Figure 116. Feeder services offered by MSC from Piraeus (I) (*source: MSC*)

Figure 117. Feeder services offered by MSC from Piraeus (II) (*source: MSC*)

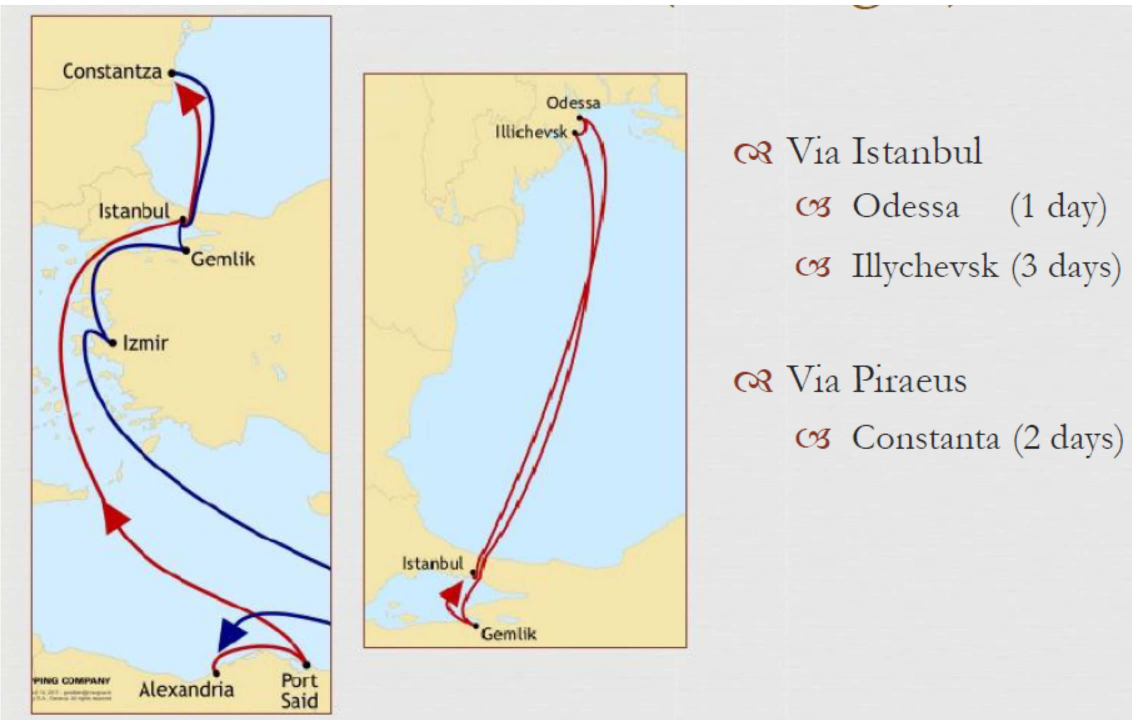


Figure 118. Feeder services offered by MSC from Ambarli (I) and from Piraeus (III) (*source: MSC*)

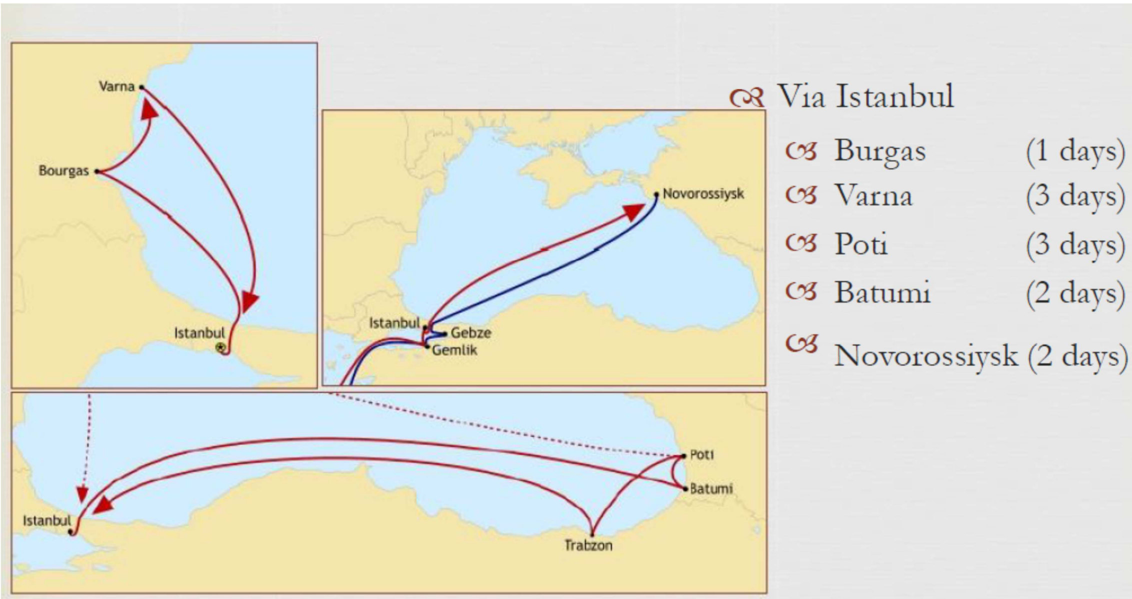


Figure 119. Feeder services offered by MSC from Ambarli (II) (*source: MSC*)

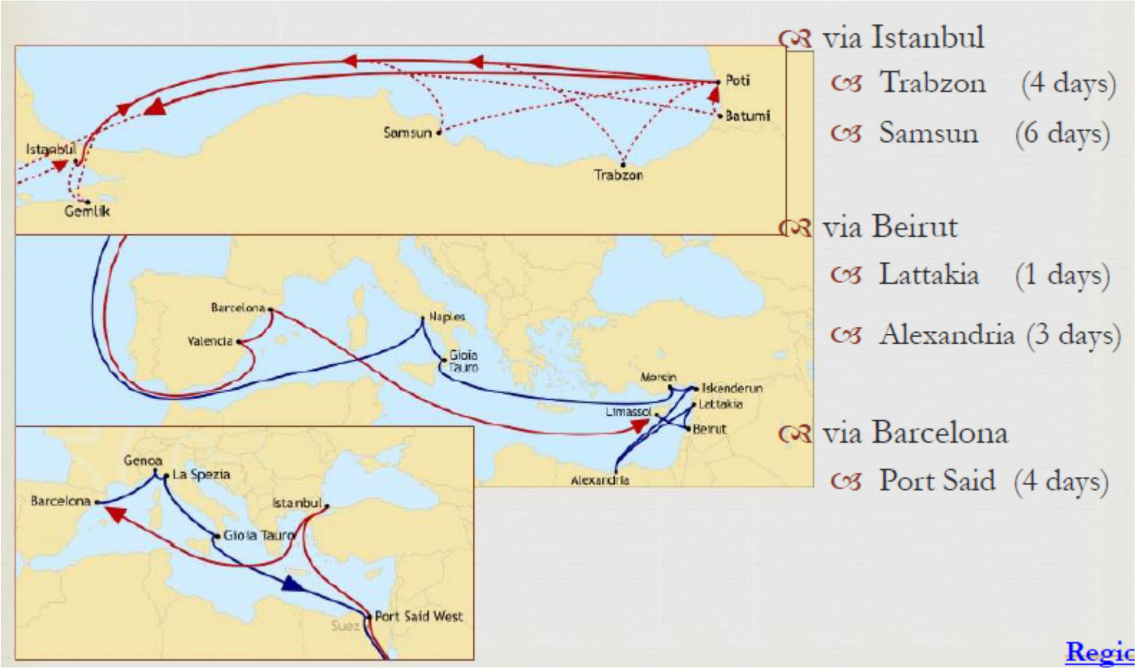


Figure 120. Feeder services offered by MSC from Ambarli (II), from Beirut (I) and from Barcelona (II) (*source: MSC*)

Concerning the future changes, MSC does not plan to introduce bigger vessels in its fleet. Currently its biggest vessel has 16.000 TEU Capacity. This is different from other shipping companies such as COSCO and CSCL, which already ordered to Korea the construction of three 18.000 TEU capacity vessels.

MSC does not plan to apply any change in terms of feeder services offered from the Mediterranean Europe market, as the relation is currently stable. MSC will keep exporting a lot of cargo from mainland China to England by feeder services from a Mediterranean European Port, as they have been doing until now. However, for MSC the limitation of 2.000 TEU capacity of the current feeder vessels may be increased to 4.000 TEU in the near future.

With other parts of the World, especially with Africa, there will be a lot of changes in the shipping industry. In 2013 Xi Jinping, China's former president, went to Africa and gave a lot of money to the local people with the only condition that they must buy products made in China. This means that the number of shipping services between mainland China and Africa will increase a lot in the next years. MSC, for example, will introduce in June 2014 a new service called Africa Express, which will go directly from the main Chinese ports to the main African Ports.

Currently MSC has leverage in some ports in Europe. MSC is interested in acquiring new terminals in other Ports of Europe, because after they can save a lot of money for using it. Moreover, they have no intention of offering new door-to-door services, and they also will not increase the hub and spoke maritime services unless the volumes transported from the ports increase.

When talking about the Chinese side, MSC thinks that Shanghai will be in the future a transhipment port, like now is Singapore. This will happen because Shanghai is becoming more expensive, so industries are moving from Shanghai to inland China, and therefore Shanghai will become a transhipment port rather than a loading port.

Shipping company 2: China Shipping Container Lines – Jiang Jianqiang

The following information was extracted after an interview with Jiang Jianqiang, the general manager of the Europe lines division operation at China Shipping Container Lines.

Among the maritime services from mainland China to the Mediterranean Europe, Shipping Company 2 (CSCL) only has direct calls at Barcelona, Genova, Marseille Fos and Valencia. The rest of the Mediterranean European Ports can be reached by using slots in other carriers. This is because CSCL does not have its own feeder services in the European Mediterranean ports. Their procedure is the following: they have presence in 4 ports in Europe, while COSCO has presence in 6. Therefore, they decide to work together and use slots in each other's vessels and there is no need of feeder services.

The service vessel fleet of CSCL has 8.500 TEU capacity and it is operated by a joint venture, from which CSCL shares weekly 1.800 TEU. The number of vessels that go weekly from mainland China to each Mediterranean port mentioned above is 1. So this means that CSCL sends weekly 1.800 TEU from mainland China to Barcelona, Genova, Marseille Fos and Valencia, respectively. In the case there is no truck service from these four ports to the final destination, CSCL also provides feeder services inside Europe.

Currently CSCL has shares in Zeebrugge port, but not in any of the Mediterranean Europe ports.

Concerning the decision criteria when choosing its transhipment port in Europe, CSCL gives the following punctuations from 1 (less important) to 10 (most important):

Decision variable	Punctuation (1 to 10)	Comments
Proximity to the final hinterland destination	3	

Leverage in the Port	5	
Alliance (the decision is conditioned by the alliance membership)	2	Currently CSCL is not a member of any alliance. However, it is a partner in a joint venture with UASC and COSCO, as said before. Other alliances of CSCL are with CMA CGM, Evergreen Marine and Yang Ming Line.
Services and facilities in the terminal	6	For CSCL, now all the terminals in the developed countries are good enough. Maybe in North Europe they are better but in South Europe they are still very good.
Sea distance from the origin to the Port	3	Not important because the difference between two Mediterranean Ports in terms of km sailed is very small.
Port call and berth requests	NO	
Port taxes (Port Authority taxes)	5	
Port taxes (terminal taxes)	5	For CSCL there is no big differences between two European Ports in terms of Port taxes for using the terminal. CSCL insisted that only a 5% of the total cost of shipping a container from mainland China to Europe is due to the Port requirements at the destination. The other 95% of this cost is in terms of petrol, the acquisition of the vessel and labour costs. Therefore, CSCL insisted during the whole interview that they do not care to much about the port election because the differences in cost from changing from one Mediterranean Port to another one are small. Also, another reason they give is that the most important thing when selecting a Port is where the consumption market is.

Degree of saturation (rate of usage of the Port)	8	This is important for CSCL, same as the technical condition of the terminal, because it is a necessary condition that these two requirements are fulfilled.
Technical condition of the terminal	10	
Door-to-door cargo influence in the Port	5	These door-to-door services are usually provided by the shipping carriers.
Communication / customer service / language	2	For CSCL, this is not very important because every port can provide it, even in third developed countries like in Africa.
Good transit policies (customs declaration, inspections, etc.)	6	
E-commerce: Shipment instructions	2	For CSCL, all the e-commerce services are not very important because every port can provide it.
E-commerce: Tracking	2	
E-commerce: Invoicing and payment	2	
Green logistics chain	5	This is a trending area and CSCL also cares about the green logistics chain. For example, recently CSCL has acquired a new terminal in LA, and from the Port Authority they were required in some cases to use electricity instead of petrol. In terms of costs this measure is not profitable, but in terms of social responsibility is important for CSCL.
Other: …………………………………… ……………………………………………...		

Concerning the services that can be improved in the operation ports of CSCL in Europe, the interviewee reaffirmed its position by saying that all the Ports they use belong to developed countries, so the differences between them are very small. For CSCL, no matter how hard tries a port to reduce its costs to offer cheaper services to carriers, because no one will change from one port to another if the consumption market is not there because then the ongoing costs would be much higher than what they can save.

For CSCL, the 4 ports operated (Barcelona, Genova, Marseille Fos and Valencia) are not transhipment ports, but gateway ports. The transhipment port in Europe of CSCL is Piraeus. Malta and Algeciras could also be used as a transhipment hub, but CSCL does not use it because it prefers to use slots in other carriers' vessels.

Concerning the future changes, CSCL insists that the European economy is in North Europe, and that only changes concerning the transport of containerized goods from mainland China to North Europe will be applied. For example, currently the 8.500 TEU capacity vessels are being used for the transport of containers from mainland China to the Mediterranean Europe, while 14.000 TEU capacity vessels are being used for the transport of containers from mainland China to North Europe. While for the Mediterranean Europe no changes are expected in short term, in the case of North Europe in the next year 18.000 TEU capacity vessels will be introduced in order to operate the Far-East to Europe routes.

In conclusion, CSCL states that no plans of changes are expected for the Mediterranean Europe. The reason of that is that there is not a big enough consumption market in the South of Europe. If someday the situation changes and the Southern Europe economy is as big as the Northern Europe, then CSCL will change all its routes and redirect them to the South, but nowadays there is no Southern country able to compete with the Northern ones.

Concerning its 4 operating ports in the Mediterranean Sea, CSCL has no plans for operating new ones, as for the moment there are not better ports for them in the Mediterranean. Again, for CSCL all depends on economics: if there is a region in the Mediterranean that is developing faster, then CSCL will use it as its entry to Europe. When suggested about the East of Europe market, which is growing very fast in the recent years, CSCL stated that the Eastern Europe is served from Hamburg rather than from the Mediterranean Sea.

In conclusion, the main criterion for CSCL when selecting a Port of entry in Europe is the speed of development of the area they are analysing.

Information about future potential alliances of CSCL are confidential and the interviewee was not able to share them.

CSCL has no intention of increasing its leverage in any Mediterranean European Port. In the Mediterranean Sea but not in Europe, CSCL will buy some terminals in North African ports, such as Egypt.

Shipping company 3: Maersk – Diego Perdones

Data about the number of containers transported from mainland China to each of the European Ports is confidential and cannot be provided by Maersk.

Concerning the decision variables when selecting a transhipment port in Europe, for Maersk everything is reduced to an optimization problem, where the objective is to reduce the cost. What they do is first to determine where is the demand, and then calculate which is the transhipment port that will cause less costs for using it. In that sense, the leverage in a terminal of a Port is very important for Maersk, as they can save a lot of money for using it.

For Maersk the differences between European ports are also not very big, but they still solve the optimization problem with all the variables in order to select the cheapest and reasonable port.

Concerning the future changes, Maersk currently is producing 18.000 TEU capacity vessels, because they pursue economies of scale. That is because a 40% of the cost of shipping a container is in petrol, so the larger amount a vessel can carry, the more money it can be saved. However, producing bigger vessels might induce limitations when selecting the origin and/or destination Port. Maersk does not plan to produce vessels bigger than 18.000 TEU, but is constantly trying to optimize its vessels in order to carry more TEU in the same size vessel without limiting the Ports technical conditions.

Concerning future alliances, Maersk is part of the P3 Alliance, which starts running July 2014, and that consists of an alliance between Maersk, MSC and CMA CGM. What they do is to sell slots to different shipping companies minimizing the costs. They are based in London (UK). In Maersk's opinion, the future tendency is that more alliances will be created. That is because the shipping industry is an industry that has lost a lot of money, and it will not be in equilibrium again because all the shipping companies are investing a lot of resources in order to get more optimized vessels to reduce costs and therefore reduce prices. This is a vicious circle from which the only possible solution is to create alliances.

Shipping company 4: APL – Elizabeth Tay

APL does not use any hub port in the Mediterranean Sea; they use Rotterdam and Hamburg as their transhipment ports in Europe. The reason they do not use any transhipment port in the Mediterranean is the additional costs in which they will incur if doing so.

Currently APL operates in the G6 alliance, formed by APL, NYK, Hapag-Lloyd, MOL, OOCL and Hyundai. This alliance operates since April 2014, when it was approved, and operates mostly in the Northern Europe. Before, there exist the Grand Alliance (OOCL, NYK and Hapag-Lloyd) and the New World Alliance (APL, MOL and Hyundai). These two alliances were operating both the transpacific and transatlantic routes, and they decided to work together since April 2014.

Before constituting the G6 alliance, the New World Alliance (APL, MOL and Hyundai) had been operating in Northern Europe for 2-3 years. APL justifies the little operations in the Mediterranean Europe because of the little demand in Southern Europe in comparison to Northern Europe.

APL expects that there will be no changes in the next year in terms of its routes, number of operating vessels or alliances. However, together with MOL, APL is reviewing the 18.000 TEU capacity vessels, in order to introduce them from 2016.

APL has direct calls in the Mediterranean ports of Marseille, Barcelona, Valencia and Genova. The main reason for using these 4 ports is the market size. As said by the interviewee, in the South of Europe the markets to serve are basically France, Spain and Italy. Therefore, by using Marseille, Barcelona, Valencia and Genova as gateway ports, they can properly serve the hinterland in each case.

Moreover, they do not provide their own feeder services once the cargo reaches these Mediterranean ports. They use more the inland modes of transport, especially trucking, in order to serve the hinterland. This justifies why they do not use ports as Malta or Gioia Tauro, that are basically transhipment ports but they do not have a strong hinterland to serve.

Currently APL has a 6 vessels fleet operating the European ports: 5 of them operate in the North of Europe (capacities 8.000 TEU (1), 11.000-12.000 TEU (3) and 14.000 TEU (1)) and only 1 in the Mediterranean Sea (capacity 8.000 TEU). Before they had 2 vessels operating in the Mediterranean Sea, but in October 2013 they decided to close one of them because it was not profitable.

APL states that they are open to new changes in terms of their routes and number and capacity of their vessels, but only as long as these changes will provide larger benefits to the company.

Finally, APL has no leverage in any European port, because for the moment their strategies do not consist in investing in terminals. They have invested in terminals in the US and Asia (LA, Seattle, Yokohama, etc.), but in Europe not yet. In the future they do not discard to acquire a terminal or buy some shares in a terminal, but in the short-term they are unlikely to do so.

Shipping company 5: Compañía Sur Americana de Vapores – Pablo González

Compañía Sud Americana de Vapores is a Wholly Foreign Own Enterprise, with offices in China in Dalian, Beijing, Tianjin, Qingdao, Nanking, Shanghai, Wuhu, Ningbo, Yiwu, Xiamen, Fuzhou, Shenzhen, Guangzhou and Hong Kong. Their revenues are higher that US$ 3,2 billion, and they currently have 4.100 employees.

CSAV does not operate in any of the Mediterranean ports here studied (Barcelona, Malta, Valencia, Marseille, Cagliari, Tanger Med, Algeciras, Genova, La Spezia, Gioia Tauro). However, they do operate in other two Mediterranean ports: Ambarli and Piraeus, because they are focused on the Black Sea Market. The number of loaded TEU that CSAV exported from mainland China to Ambarli last year was 46.000, and to Piraeus 3.000.

Therefore, the only maritime service they currently offer from mainland China to Europe is the one called ABS, in which CSAV operates using slots in a slot charter agreement with MSC. MSC is the owner of the vessels in this maritime service. The frequency of this service is weekly, and the capacity is 11.000 TEU. The number of ships of the maritime service is 7, and the rotation is: Qingdao, Shanghai, Ningbo, Chiwan, Hong Kong, Singapore, King Abdullah, Bairut, Ambarli, Piraeus, Qingdao.

For CSAV, the main operating ports in mainland China and their percentage of TEU loaded in each of them and transported to the European Mediterranean ports among the total number of TEU shipped by them from mainland China to the European Mediterranean ports are: Ningbo (34%), Shanghai (22%), Qingdao (19%), Chiwan (16%), Xingang (5%), Xiamen (4%).

When choosing a transhipment port in Europe, the most important decision variable for CSAV is the technical condition of the terminal, followed closely by the transit policies of the port (customs declaration, inspections, etc.), the degree of saturation (rate of usage) of it and the port taxes. After, the services and facilities in the terminal and the proximity to the hinterland destination are also quite important. Finally, the alliance, the sea distance from the origin port, the communication/language/customer service and all the e-commerce services are the less important decision criteria when choosing their transhipment port in Europe.

Concerning the two operating ports of CSAV in Europe, the services that could be improved in each of them are the following:

- **Ambarli**: berthing facilities. The terminal is not up to date in terms of the facilities, in comparison to the importance it has gained in the past few years (it is a very simple set of finger piers).

- **Piraeus**: reliability. Even though in the past two years it has been quite stable, it has a bad reputation of successive strikes that completely stop their operations for long periods of time.

When shipping from mainland China to Europe, CSAV prefers to concentrate big volumes in traffics with a lower number of scales, feeding later other ports by feeder services; rather than offering traffics with a high number of scales (reducing transit operations). Therefore, the type of port preferred by CSAV is a hub port rather than a gateway port. This also explains why they currently operate from Ambarli and Piraeus, which are hub ports rather than gateway ones.

CSAV does not provide its own feeder services in the Mediterranean Europe. Out of the 46.000 TEU shipped yearly by them from mainland China to Ambarli, 22.500 TEU are after transhipped by a feeder service. The main destinations of these transhipments are: Novorossiysk (Russia), Poti (Georgia) and other ports in Turkey. On the other hand, none of the 3.000 TEU shipped yearly by them from mainland China to Piraeus is after transhipped.

Concerning the future, CSAV does not expect any significant changes in their maritime services from mainland China to the Mediterranean Europe in the next years, neither in its vessels capacity, length or weight, nor in its maritime services offered or potential new alliances. Also, they do not plan to invest in new terminals in the Mediterranean Sea for the moment.

Shipping company 6: NYK – Jason Seo

Currently NYK provides direct services to Barcelona, Genova, Fos and Valencia, same as APL because they work together in the same alliance: G6. The service that G6 offers to the Mediterranean Europe is called EUM, and it consists in 1 service per week of capacity 8.000 TEU. Before G6 alliance offered 2 services per week to the Mediterranean Sea, but they closed one at the end of last year because it was not profitable. At the same time, NYK, as part of the G6 alliance, offers 5 more maritime services to Northern Europe (3 of capacity 11.000-12.000 TEU, 1 of capacity 14.000 TEU and 1 of capacity 8.000 TEU).

NYK currently does not own any terminal in the Mediterranean Europe. In mainland China, it operates mainly in Shanghai, Shekou and Yantian, but as part of the G6 alliance, also in Ningbo, Qingdao, Dalian and Xingang.

Concerning the election of its operating ports in Europe, NYK states it is all about costs. In that sense, most of the services offered by NYK are in Northern Europe, because the fixed costs are lower. For example, the main transhipment port for NYK in Europe is Hamburg, where the costs are much lower and the feeder service options are wider.

After the costs, the second most important condition that NYK looks for in a port is the service availability. This is very important because not all the ports offer transhipment services from one point A to another point B.

Another very important condition for NYK when choosing a port in Europe is the round trip amount of containers shipped. For example, if NYK sends 400 containers weekly from mainland China to Barcelona but only 100 of them go back to mainland China loaded, then the fixed costs for the company are very high. That is why the rotation of the maritime services offered by NYK is related to the amount of round trips offered by that port.

NYK currently offers door-to-door services in Europe and the US, but they use their logistics group for that. NYK prefers to offer maritime services with a higher number of scales, reducing transit operations, rather than concentrating big volumes in traffics with a lower number of scales (feeding later other ports by feeder services). This is because NYK cares a lot about the loading condition of its containers, and the way of ensuring that the containers shipped are loaded is by doing a large number of scales. However, NYK knows that from the customers' point of view, the second option would be more attractive.

NYK does not offer its own feeder services; it uses the common ones offered at the destination port. Concerning the future, NYK this month ordered 4 new 14.000 TEU capacity vessels, and they are considering the option of buying 4 more. These 4 new vessels will operate in Northern Europe.

In summary, now the G6 alliance operates 5 maritime services from mainland China to Northern Europe and 1 to Southern Europe. In total these 6 services are operated by approximately 60 vessels, all having different sizes. NYK plans to locate the 4 new 14.000 TEU capacity vessels in the Northern Europe services, therefore displacing some of the current vessels operating in the North to the Mediterranean Sea. The new vessels will be more efficient, safe, ecologic and profitable than the old ones, and that is the reason why NYK wants to replace them.

However, now NYK does not consider the possibility of introducing vessels of capacity 18.000 TEU. NYK thinks that the vessels of capacity 14.000 TEU are more efficient and ecological than the 18.000 TEU ones. Moreover, NYK thinks that the higher the capacity of the vessel, the larger the number of stops in the rotation in order to completely load it.

Concerning the alliances, NYK states that currently all the main carriers operate in alliances, and therefore in the next future no changes are expected in this area. However, if any of the carriers disappears from the market or if some unexpected phenomenon occurs, there can be changes in the current existing alliances.

About the future changes in the maritime services offered, for NYK it is all about the economy: if there is a region in Europe that starts to grow up very fast, then of course new routes will be opened to feed it. But currently the situation is very stable in the Mediterranean Sea.

Finally, about the leverage in Mediterranean ports, NYK does not plan to invest in any port by acquiring a terminal because it says that the Mediterranean market has been poor for a long time and no big changes are expected in the near future. About the transits, NYK does not expect that they will increase in the Mediterranean Europe in the near future.

Shipping company 7: CMA CGM – Robert Lee

Regarding their confidential policies, CMA CGM could not give any figure or number about their exports from mainland China to Europe. However, they admitted that from the list of Mediterranean ports presented, they operate in Barcelona, Malta, Genova, Fos, Valencia, Tanger MED and Algeciras.

Malta is CMA CGM's hub port in Europe. All the maritime services offered by the company stop in Malta, in part thanks to the leverage that they have in this port. On the other hand, not all the services offered from mainland China to Europe stop in the other Mediterranean ports run by CMA CGM. In that case, a feeder service used from Malta would be in charge of transhipping the cargo from Marsaxlokk to its destination. Apart from Malta; Barcelona, Genova and Fos are the ports more used by CMA CGM rather than the others.

The first priority for CMA CGM when selecting its transhipment port in Europe is the cost. After that, the port facilities, its capability, policies, etc. are also important. In that sense, CMA CGM states that Malta has really good conditions for them.

Most of the cargo exported from mainland China to North Africa by CMA CGM goes to Tanger MED. Therefore, Tanger MED is a very important port for the company. However, they think that the loading and unloading capacity of the port is not good enough because its facilities are quite old.

Concerning the other European Mediterranean ports, CMA CGM affirms they are good enough. It is true that there are sometimes strikes, weather phenomenon, congestions, etc. But, in their opinion, it is hard to improve these unpredictable things. Generally speaking, for CMA CGM the two ways of improving any Mediterranean port services would be increasing the working efficiency and the facilities.

CMA CGM does not have its own feeders in the Mediterranean Europe; they use public feeders.

Concerning the vessels' capacity, in the third quarter of this year CMA CGM will introduce its biggest vessel until now. It will be a 16.000 TEU capacity vessel and it will be included in the P3 alliance (together with Maersk and MSC).

CMA CGM believes all the ports in the Mediterranean Europe are well prepared for receiving these 16.000 TEU capacity vessels. They insist, however in the fact that they are facing difficulties when trying to export containers from mainland China to Hamburg. In their opinion, Hamburg is not an efficient port because it is very old and it has depth problems, despite its large tradition for being a transhipment port. That is why CMA CGM, together with the P3 alliance, will operate their vessels in Wilhelmsburg, a new port close to Hamburg with improved facilities and with a huge potential.

Currently CMA CGM offers 5 maritime services from Asia to North Europe and 3 from Asia to the Mediterranean Europe. In the near future CMA CGM will offer 8 services from Asia to North Europe and 5 from Asia to the Mediterranean Europe. This means that the company plans to increase its offer both in Northern and Southern Europe.

Concerning future new alliances, after just signing the P3 one, in the near future the company has no intention of creating new ones.

Finally, CMA CGM states that they have a very strong door-to-door service, because they have relations with all the logistics companies operating in the main European ports. In the future they specially have interest in increasing these door-to-door services, but they also plan to increase the hub and spoke services and the transits to transoceanic routes.

Shipping company 8: COSCO – Yang Lei

Last year COSCO shipped approximately 1,7 million TEU from mainland China to Europe. The number of containers sent weekly from mainland China to North Europe (13.000 TEU) by

COSCO is the double than the number of containers sent weekly from mainland China to the Mediterranean Europe (6.500 TEU).

In the Mediterranean Europe they use the following ports: Barcelona, Valencia, Genova, Fos, Algeciras, Piraeus. Information about the exportation from mainland China to these ports by COSCO is the following:

- Piraeus: COSCO ships more than 2.000 TEU weekly from mainland China to Piraeus. Out of them, 600-800 TEU are local cargo (distributed to the hinterland) and the rest is transhipped to another final destination (to North Europe, to the Black Sea, etc.). The destination of these transhipments is mainly Turkey and the Black Sea.

- Genova: COSCO ships approximately 1.200 TEU weekly from mainland China to Genova. Out of them, 900 TEU are local cargo (distributed to the hinterland) and 300 TEU are transhipped to another final destination. The main destination of these transhipments is West Africa.

- Barcelona: COSCO ships approximately 1.000 TEU weekly from mainland China to Barcelona. Out of them, 400 TEU are local cargo (distributed to the hinterland) and 600 TEU are transhipped to another final destination. The destination of these transhipments is mainly Africa, in particular Algeria (90%).

- Valencia: COSCO ships approximately 350 TEU weekly from mainland China to Valencia. Out of them, 250 TEU are local cargo (distributed to the hinterland) and 100 TEU are transhipped to another final destination. As it is seen, Barcelona is a higher transhipment port than Valencia. COSCO says that Valencia is better located than Barcelona for transhipments, but that currently for them the policies for using Port of Valencia are worse than Barcelona. As the maritime services offered by COSCO from mainland China to the Mediterranean Europe first call in Barcelona and after in Valencia, it is easier to do all the transhipment arrangements in Barcelona rather than in Valencia. However, this situation can change in the future.

- Fos: COSCO ships approximately 250 TEU weekly from mainland China to Fos. All of them are local cargo, since none of these 250 TEU are transhipped to another final destination.

- Algeciras: COSCO ships approximately 20-30 TEU weekly from mainland China to Algeciras. Almost all of them are transhipped to another final destination. Algeciras is a relatively new port for COSCO. Before they used to ship more containers from mainland China to Algeciras (around 150-200), but due to increasing Port of Algeciras operating costs, now COSCO avoids using it. The main destinations of the transhipments from Algeciras by COSCO are Portugal, North Africa and the north of Spain (Bilbao, Vigo).

COSCO currently offers four maritime services from mainland China to the Mediterranean Europe:

- MED1. Together with Hanjin.
- MED2. Together with K Lines and Yang Ming Line.
- Slots in an Evergreen service.
- Slots in a China Shipping Container Lines service.

The weekly capacity of all these services is approximately 6.500 TEU.

COSCO does have leverage in two Mediterranean ports: Piraeus and Napoli. In North Europe they also have leverage in Rotterdam and Antwerp.

Their main operating ports in mainland China for COSCO when exporting containers to Europe are Shanghai and Ningbo (approximately one third of the total), Yantian (approximately one third of the total too) and also Xiamen, Xingang, Qingdao, Dalian, Shekou (all of them together the last third of the total).

When choosing its transhipment port in Europe, the most important variable for COSCO is the location of the port, which includes both the location in terms of the hinterland proximity and in terms of the maritime route proximity. Therefore, the sea distance to the port is not a very important decision variable for COSCO. For example, Algeciras and Ambarli are both well located to adopt transhipment services, but COSCO uses Algeciras because of its better conditions. So the location close to the majority of the maritime lines is important when choosing a transhipment port in Europe because it is more cost efficient.

On the other hand, the port and terminal condition is also very important. In order to distribute the local cargo, the port must be well connected to the hinterland. When talking about transhipment, the local policies for transhipments are very important, because the situation can change very fast (volatile). In that sense, some ports are very strict about inspections, and a lot of customers do not like that. Thus COSCO tries to avoid these ports where the inspections are very strict.

Finally, in the Mediterranean Sea another important decision variable for COSCO when choosing a transhipment port is the green logistics chain. COSCO is trying to convince its customers about the necessity of using an environmentally friendly way of transporting goods. In that sense, exporting containers from mainland China to North Europe instead of the Mediterranean Europe implies 20% more petrol consumption. That is why COSCO is introducing to its customers the possibility of using Southern Europe ports as a south gate to Europe. COSCO states that this maybe now is not very important, but in the future it will become more and more crucial in the exportation of containers from mainland China to Europe.

COSCO offers door-to-door maritime services. When talking about these kinds of services, COSCO differentiates between the ports' hardware and software. The hardware is related to the port facilities, the connections to the hinterland, infrastructure condition, etc.; while the software is related to the way of working of each port, its tracking capability, management, etc. From COSCO point of view, a port having a good software but not so good hardware means it can release cargo smoothly but it has not enough facilities to arrange it. On the other hand, a port having a good hardware but not so good software means it will have problems when unloading and loading the cargo. Therefore, COSCO states that both hardware and software must be in equilibrium. This is because in door-to-door services everything must be under control in order to offer a good service to the customer.

Concerning the services that could be improved in each port, COSCO thinks that the Italian ports (Genova, Livorno, La Spezia, Napoli, Gioia Tauro) should improve their hardware. Some of these ports have problems with their equipment facilities or railway connections. Their main problem is that they cannot combine the local cargo distribution with the transhipment distribution. For example, Gioia Tauro and Taranto are pure transhipment ports, while La Spezia, Genova, Livorno, etc. are pure local cargo ports.

On the other hand, COSCO thinks that Valencia and Barcelona combine efficiently the local cargo distribution and the transhipment services because both are important for them. COSCO affirms that all the shipping lines call these two ports because they have good connections to everywhere, especially to Africa. However, for COSCO the problem of these Spanish ports is the software: customs offices have different and very complicate policies. And also another important service to improve from these ports is the business manners: COSCO thinks that for the transhipment activities from Valencia and Barcelona now you need the support of local companies because they do not have an international view. In conclusion, although Barcelona and Valencia ports hardware is good enough, the local business efficiency is not high enough.

In addition, from COSCO's point of view, Greek ports have a special advantage because of their good location. That is why COSCO invested there some money in the past few years. They think that in the future the Black Sea market will be very important because it will be well connected by railway and road to Central Europe.

Finally, COSCO does not expect too much from Fos concerning the transhipments because it is focused on local cargo and they do not like how it works as a transhipment port.

COSCO has recently changed its business strategy. Now they are thinking about reducing the operations in some Mediterranean ports step by step. Instead, they will invest in big capacity vessels that will call fewer ports. For instance, last year COSCO called directly at Napoli, but now it uses feeder services from Piraeus to serve it. The intentions of COSCO are justified by saying that the bigger the vessel, the fewer the number of calls. In part this is because not all ports can receive these big vessels. COSCO states that 3.000-4.000 TEU capacity vessels can call a lot of ports and after provide door-to-door services, but 15.000 TEU capacity vessels cannot call a lot of ports because then the transit times will be too high.

COSCO does have its own feeder services, but they do not have many. Currently, COSCO has its own feeder services from Piraeus to Turkey and to the Black Sea. From Barcelona and Valencia COSCO uses the common feeder services. They state that in the future they will invest in their own feeder services from the Mediterranean Ports.

COSCO thinks that the shipping industry will not go back to the situation before 2008. Now the shipping industry has over capacity, and then COSCO thinks it is not a good idea to invest in big vessels. They are ordering and they will order new vessels, but only to replace the old ones. The new orders are vessels bigger than the current ones, but around 13.000-14.000 TEU capacity (no intention of introducing 18.000 TEU capacity vessels). In the Mediterranean Sea COSCO plans to increase the capacity of the operating vessels, but at the same time reduce the number of them.

COSCO states that they will extend the services they offer depending on the development of their feeder network. If they can build a solid network, then they will provide more and more destinations to customers. However, the direct calling will be less and less gradually.

COSCO belongs now to the Green Alliance, formed by COSCO, K Line, Yang Ming Line, Hanjin and Evergreen. Before the alliance was only constituted by COSCO, K Line and Yang Ming Line, but after Hanjin joined and in April 2014 Evergreen joined.

About the intentions of investing in Mediterranean ports, COSCO plans to invest a lot of money in the Mediterranean ports. However, all these decisions belong to COSCO Pacific, which is located in Hong Kong. COSCO pressures them in order to invest in European ports terminals in order to reduce operational costs.

Finally, in the future COSCO intends to offer more and more services to the customer, no matter what kind of service it is. Therefore, they follow the customers' preferences.

PART 2. URBANIZATION PROJECT OF STREET 114. CONNECTION BETWEEN L'ESTANY DEL PORT AVENUE AND STREET 114 (PORT OF BARCELONA)

DOCUMENT Nº1. PROJECT REPORT AND ANNEXES

PROJECT REPORT

1. Introduction

Due to the south extension of the Port of Barcelona, new accesses to the Port had to be built in order to ensure the communication between the Port and its surroundings. In this context, in December 2010, Port Authority of Barcelona ordered the construction of the new accesses to the new area of the Port.

In the previous studies, three different stages or scenarios where considered concerning the implementation of the road accesses to the South Extension. These possible scenarios are related to relevant milestones in the development of the Port infrastructures:

- **Stage 1**. Starting of the new container terminal at Prat quay, from now on Tercat, which at the same time can be subdivided between the starting of the Tercat container blocks in its phases 1A and 1B.

Figure 121. Phase 1A in the south connection (2011) (*source: Esteyco)*

The first phase, currently finished, arose as a necessity of guaranteeing the Tercat road accesses from L'Estany del Port Avenue and from Street 4, always considering its compatibility with the future constructions of phase 2.

For that purpose, a perimeter road that tried to be tight enough to the road of the second phase was defined, in order to build as much as possible in this area. In that sense, a traffic roundabout that almost coincided with the return path vial was defined. This return path vial allowed through this traffic roundabout access the South dike works and to Tercat. The vial system of this phase was completed with a vial access to Tercat for light vehicles and another one that connects to Ronda del Port.

These vials rested on the ground (height 4 approx.) except those axes that due to coinciding with those ones of phase 1B adopted the future flush (return path vial and access platforms to Tercat).

Phase 1A was in service in the south connection part, at least during the preloading and the execution of the final path vials. Once these ones were executed, those that lost their utility because their functionality was doubled were dismantled. Therefore, the only path vial that was still in service was the one that accessed the south dike works.

In Ronda del Port and connection with Street 4 it was necessary to define two axes that allowed the differentiation between the definitive and the provisional stretch of Ronda del Port. The provisional stretch started in advance so it allowed the execution of the access solution to the logistics zone 2 in a different level without affecting the definitive segment of Ronda del Port executed in phase 1A. The fact of moving Ronda del Port path vial to the East forced to replace the current truck parking area.

The logistics zone 2 access was done in phase 1A by a T intersection with left turns and lights.

- **Stage 2**. Starting of the truck highway. The main works in this stage 2 were:
    - Execution of the North Connection.
    - Pavement of Ronda del Port East Roadway.
- **Stage 3**. Connection to the South Extension. In this stage coincided the connection together with the future extension of the terminal. In this stage would have been completed, if necessary, all the direct connections of the South Connection.

2. Purpose of the project

Due to the construction of the new accesses to the South Extension of Port of Barcelona, there arose the necessity of including actions that, although they were out of the strict geographical area of the new accesses, influenced importantly the right operation of the infrastructures defined.

The purpose of the project suggested here is to define – in a constructive project level – the necessary actions to reshuffle the existing intersection between L'Estany del Port Avenue, Street 100 and Street 114 by that time, as they were part of the natural itinerary of arrival to the South Extension of Port of Barcelona, in Prat del Llobregat municipality.

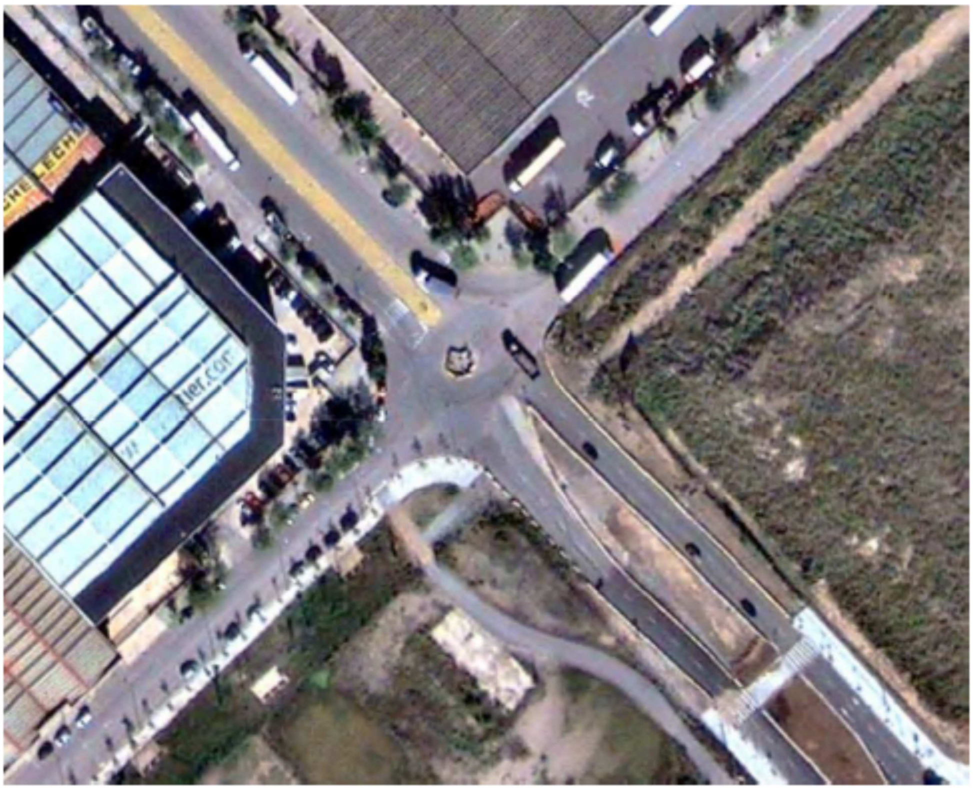


Figure 122. Aerial view of the scope (2011) (*source: Esteyco)*

At that time the intersection worked as a mini traffic roundabout, delimited by new jersey mobile walls, which influenced in its functionality and capability.

Moreover, the intersection presented drainage problems when there were important rainfalls due to the flush and the existing drainage system characteristics, which generated obvious difficulties to the traffic circulation.

Figure 123. Intersection situation (2011) (*source: Esteyco)*

Figure 124. Drainage problems existing in the intersection (2011). Street 114 – Street 100 (*source: Esteyco)*

Another problem that has to face the construction project is to guarantee the pedestrian and cycling traffic from and to L'Estany del Port Avenue, in terms of commodity and safety. Therefore, the objectives of this urbanization project are the following:

- To improve the capacity of the existing intersection, tidying the existing traffic movements. This results in higher circulation fluency and in a vial security improvement.

- To finish the urbanization of L'Estany del Port Avenue, allowing giving continuity to the pedestrian and cycling itineraries.

Figure 125. Connection between Street 114 and l'Estany del Port Avenue (2011) (*source: Esteyco)*

- To improve the road safety by building high fords at the driving crossings for pedestrians and cyclists.

- To improve the existing drainage conditions by building new inlets and manifold networks, therefore avoiding the existing roadway inundation problems.

- To allow with the minimum traffic modifications and alterations, the subsequent extension of the Street 114 to Barcelona, according to the existing planning.

- To improve the urban area image giving uniformity to the architectonic treatments, ending up with the existing provisional image and consolidating the zone as an important communication joint.

3. Description of the adopted solution

3.1. Topography

The topographic map is done by a GPS GR-1 Topcon – in order to get data about the planimetry and altimetry – and by a Total Station Topcon GPT-3005 – in order to get data about specific points –.

Before starting the field work it was requested to the Port Authority of Barcelona the existing vertexes or topographic bases in the area. Port Authority of Barcelona provided a copy of the memory that contains the geodetic network of Port of Barcelona in 2011.

At that time, and due to the duplicity of the reference systems in which the coordinates were determined, it was suggested by the Port Authority of Barcelona to solve it by using the reference system ED50 for (X,Y) coordinates and the reference system ETRS89 for (Z) coordinate.

The nearest base to the project site was BR 275. Related to it, there were fixed two stakeout bases F-1 and F-2, which coordinates were calculated by GPS.

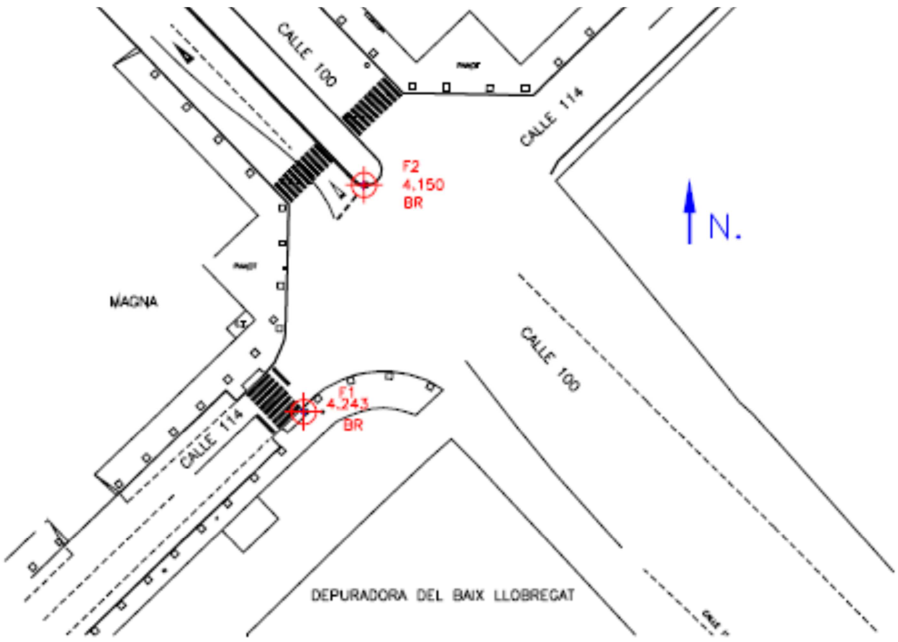


Figure 126. Sketch of the new stakeout bases F-1 and F-2 (*source: Esteyco)*

Table 177. Coordinates of the stakeout bases F-1 and F-2 (*source: Esteyco)*

	X	Y	Z
F1	426799.785	4574270.486	4.243
F2	426809.593	4574307.441	4.150

Once the coordinates of the stakeout bases were calculated, the topographic map of the area was carried out indicating for each of the selected points their code and corresponding coordinates. The map was drawn by the radiation method using a Total Station from the stakeout bases.

Afterwards, the data stored in the Total Station was sent to the computer and the points were drawn in their corresponding layers. The digital model of the area was then triangulated and curved every 10 cm.

3.2. Geology and geotechnics

The study had as its main objective to characterize from a geological and geotechnical point of view the land affected by the trace. The study was based on the recompilation and analysis of the information from previous studies available of geological and geotechnical nature.

From a geological point of view, the studied zone is located in the Llobregat River delta. It is a sedimentary environment formed by quaternary deposits in which evolution have intervened simultaneously both fluvial processes and coastal processes typical from the coastal dynamics (storms, tides, drifts, etc.).

The geotechnical units involved were the following.

GU. 1. Sands and gravels

This unit is formed by detrital granular sediments with the following geotechnical characteristics:

Saturated density: 21 kN/m^3
Permeability (horizontal and vertical): 1 m/day
Effective cohesion: 1 kPa
Effective friction: 38º
Elastic modulus: 200 MPa

GU. 2A. Clean beach sands

This unit is characterized by its high heterometric sands content (beach sands), of medium compactness, with centimetric and decimetric levels of silts and clayey silts. It has the following geotechnical characteristics:

Saturated density: 20,7 kN/m^3
Permeability (horizontal and vertical): 1,37 m/day
Effective cohesion: 1 kPa

Effective friction: 38º

Elastic modulus: 25 MPa

GU. 2B. Fine sands and silts

At a wall behind the sand stratum there is the detritus intermediate unit, in which predominate the fine sands and silts with clayey silts collations. It is a non-plastic material, of low-medium compactness, formed by lands classified mostly as “inorganic silts and very fine sands: clean silts; fine, silt or clayey sands; clayey silts with a little plasticity”. It has the following geotechnical characteristics:

Saturated density: 19,9 kN/m^3

Permeability (horizontal): $6{,}52\cdot10^{-3}$ m/day to $2{,}57\cdot10^{-2}$ m/day

Permeability (vertical): $1{,}63\cdot10^{-3}$ m/day to $6{,}43\cdot10^{-3}$ m/day

Effective cohesion: 30 kPa

Effective friction: 30º

Non-drained cohesion: $0{,}25\cdot\sigma'_v$

Deformation modulus: 17 MPa

GU. 2C. Clays and silts

Under the silt unit there is a gradual changing to the most cohesive level formed by clayey silts and silt clays with centimetric collations of soft and plastic clays, sandy silts and granular layers. It has the following geotechnical characteristics:

Saturated density: 19,4 kN/m^3

Permeability (horizontal): $2{,}38\cdot10^{-3}$ m/day

Permeability (vertical): $5{,}95\cdot10^{-4}$ m/day

Effective cohesion: 15 kPa

Effective friction: 25-30º

Non-drained cohesion: $0{,}25\cdot\sigma'_v$

Deformation modulus: 20 MPa

GU. 3BIS. Superficial clays

It is an old natural surface formed by the deposits associated to the recent inundation activity from Llobregat river. It has the following geotechnical characteristics:

Saturated density: 20,7 kN/m^3

Permeability (horizontal): $1{,}34\cdot10^{-2}$ m/day

Permeability (vertical): $3{,}35\cdot10^{-3}$ m/day

Effective cohesion: 20 kPa

Effective friction: 30º

Non-drained cohesion: 17 kPa
Deformation modulus: 10 MPa

Concerning these materials, it must be stated the following:

- The unit presents a very limited power.
- The presence of superficial anthropic fillings has actuated among these materials as a preloading effect.
- The superficial position of these materials locates them inside the area of influence of the past years' traffic overload.
- Both above and next to this unit there exist granular materials with high drainage properties.

All these considerations indicate that the current GU. 3BIS. geotechnical properties inside the area of influence of the project are notably higher than the original ones. In consequence, it must be expected that the consolidation process of these materials is in an advanced stage and that its consolidation deformations will be limited and distributed in time (consolidation and creep).

GU. 3. Anthropic fillings

The anthropic fillings represent the field support of the project actions. They present a thickness between 2 and 3 meters. They are, in general, consolidated materials by compaction and due to the vehicles traffic above them. Some of these materials are placed as fillings located around the services installations (collector, pipes, etc.) or as preloading materials. Therefore, and based on the lab analysis and the compaction degree expected, the anthropic fillings must be considered as embankment fillings, which deformations will be reduced and limited to the work stages. They have the following geotechnical characteristics:

Natural density: 19,5 kN/m^3
Saturated density: 20 kN/m^3
Permeability (horizontal and vertical): $1{,}2\cdot10^{-3}$ m/day
Effective cohesion: 1 kPa
Effective friction: 40º
Elastic modulus: 22,5 MPa
Horizontal modulus of ballast: 5.000 kN/m^3
Excavations up to 5 m height: 1H:1V

In the project area, the water table is frequently conditioned by the maritime level, situated at the relative dimension -4 m (0 m.a.s.l.). The available results of the chemical analysis of the water samples extracted from the area reveal that the groundwater has a high degree of aggressiveness against concrete.

In the following image the stratigraphic column of the stress-strain studied area is shown, in order to verify the strains induced by the implementation of the projected work.

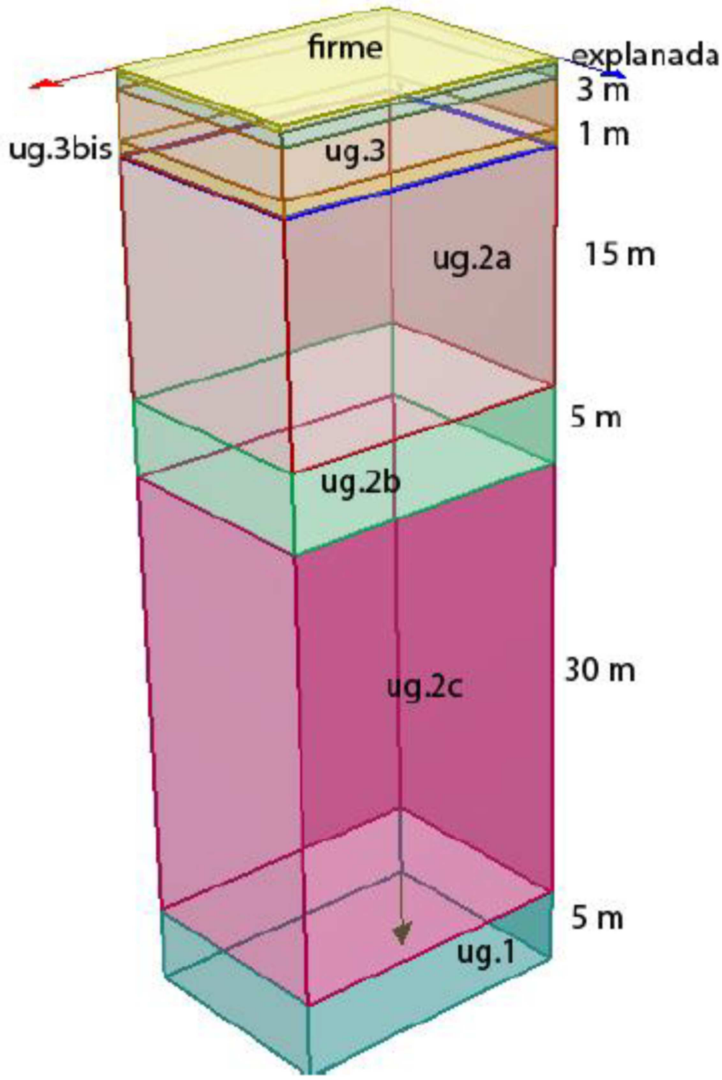


Figure 127. Stratigraphic column of the stress-strain studied area (*source: Esteyco)*

As a result of the stress-strain study carried out, it is observed that the immediate seating expected is very small (< 1 cm) and, consequently, negligible.

In order to satisfy the project materials necessity it is necessary to appeal to external holdings, such as limestone or gravel quarries. To do that, an inventory of 6 mining sites, 3 concrete plants and 2 installations for the preparation of asphalt mixtures is done.

3.3. Layout

In order to carry out the complete definition of the project, it is necessary to define the following axes:

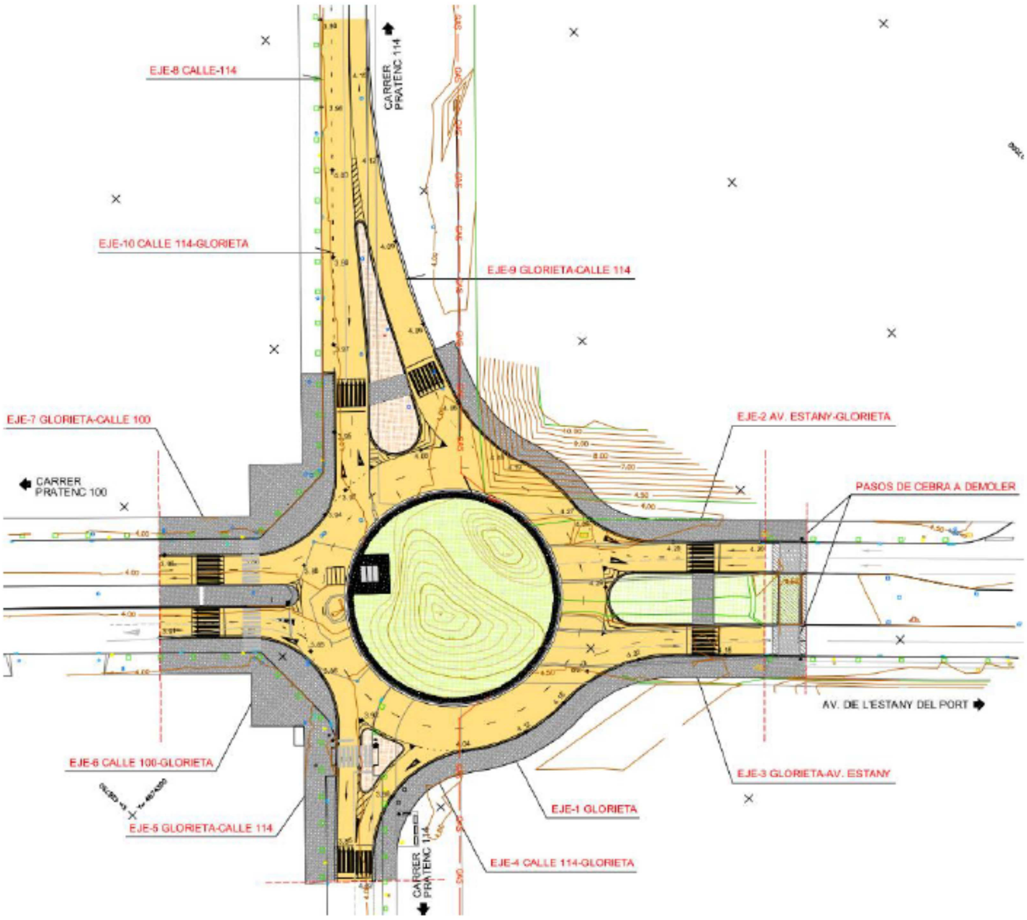


Figure 128. Map of the suggested solution (*source: Esteyco)*

Table 178. Calculation axis (*source: Esteyco)*

Axis 1	Traffic roundabout
Axis 2	L'Estany del Port Avenue (SE) – Traffic roundabout
Axis 3	Traffic roundabout – L'Estany del port Avenue (SE)
Axis 4	Street 114 (SW) – Traffic roundabout
Axis 5	Traffic roundabout – Street 114 (SW)
Axis 6	Street 100 (NW) – Traffic roundabout

Axis 7	Traffic roundabout – Street 100 (NW)
Axis 8 and 10	Street 114 (NE) – Traffic roundabout
Axis 9	Traffic roundabout – Street 114 (NE)

The urbanization project includes as well some actions that did not require the definition of these axes. These actions are:

- Demolition of the ford pedestrian existing in L'Estany del Port Avenue, previous to the starting of axes 2 and 3.

- Modification of the current type section of Street 114, from the ending of the axes branches 8, 9 and 10 to the intersection of the Street 114 with the Street 107. This action consists in the modification by horizontal signaling of the existing type section – 2 lanes of 5,25 m width each one – by a new one – a parking of 2,50 m width and 2 lanes of 4,0 m width each one –.

The location of the traffic roundabout is conditioned by the existence of consolidated plots in the area and by the existing outline of the streets that access to it.

A traffic roundabout of 35 m outer radius is projected, and the connection is adjusted, both in front and top views, to the existing vials, respecting the existing type section in all the cases except that in Street 114 direction to Barcelona, where the type section expected in the planning is taken into account. From this point to the intersection with Street 107 the existing type section is modified by road markings, according to the definition of the new one given above. In the proximity of the intersection of Street 114 with Street 107, a transition is carried out in order to do the connection with the existing type section.

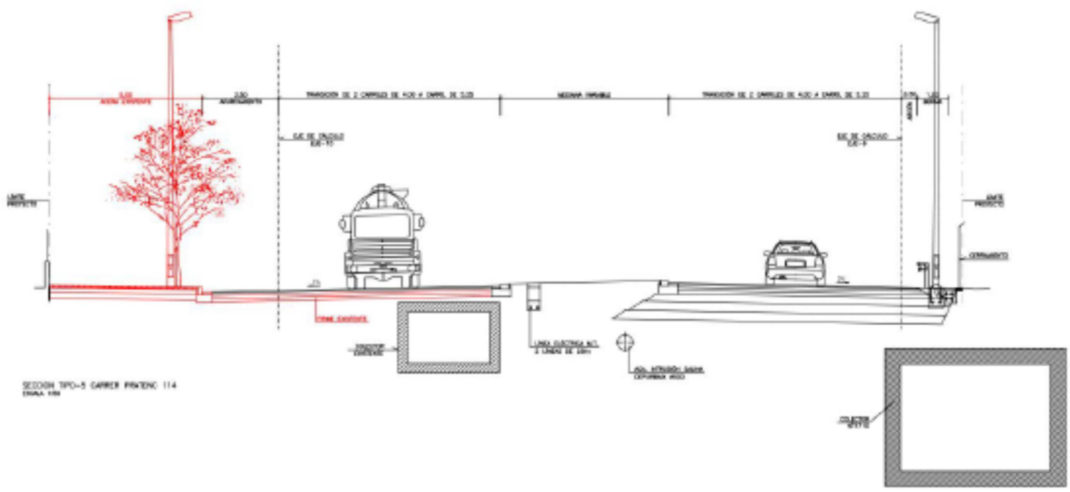


Figure 129. Existing cross-section of the road connection (*source: Esteyco)*

3.4. Ground moving

Given the characteristics of the current project, the ground moving is extremely limited. The action will be limited to the scarification, to the sanitizing of the most superficial ground layer and to the demolition of part of the existing firm package in order to carry out the lace between the projected firm packages in those zones where the future roads will be developed instead of the existing ones.

In addition, a clearance of the materials that constitute the preloading of an adjacent plot is projected, with a height lower than 5 m.

The following table contains the main units of the ground moving:

Table 179. Summary of the ground moving (*source: Esteyco)*

Land clearing (m^3)	3.626,2
Embankment (m^3)	396,6
Firm demolition (m^3)	393,3
Stabilized ground S-EST3 (m^3)	757,1
Selected ground (m^3)	757,6

3.5. Mobility and traffic study

For the characterization of the existing traffic, data from three different sources was taken:

- Manual source. It was done on September 16th 2011. It lasted 8 hours and it was carried out in the intersection. From this source it can be seen that 7.400 vehicles drive into the traffic roundabout daily. Through Street 100 drive approximately 5.000 vehicles daily (around 2.500 in each way). From all of them, approximately a 6% reverse their way. From L'Estany del Port Avenue arrive to the traffic roundabout approximately 1.800 vehicles per way. A large amount of them are trucks that have destination the extension works of the Port.

- Automatic source. Information available from an existing automatic source of information is used. It was done between the 12th and 18th of April 2011 in the Street 114. The automatic sources of information done in the Street 114 give us more reliable information about the evolution of the daily intensity during the week. It also gives us information about the peak hours and the type of traffic circulating.

- Composed source. It shows a high participation of the heavy vehicles (64%), mostly the ones with 5 axes (36%).

Once the traffic was characterized, a simulation of the traffic was done in order to check the right functionality of the traffic roundabout.

3.6. Firms and pavements

For the firms dimensioning, the norm applied was “Pavement sections. Instruction 6.1-IC”.

3.6.1. Firm section in the vials

From the simulation carried out, the type of traffic established is T00, according to the Table 1.A of the instruction 6.1-IC.

Table 180. Types of traffic according to the Table 1.A of the instruction 6.1-IC (*source: Esteyco)*

Type of heavy traffic	T00	T0	T1	T2
ADIp	>4.000	<4.000	<2.000	<800
(heavy vehicles/day)	>4.000	>2.000	>800	>200

Given that the traffic roundabout of the current project is located in L’Estany del Port Avenue, the coordination with the “Urbanization Project of the Street 100” must be kept coordinated. For that purpose, it also must be considered that in this project the type of heavy traffic obtained in the Street 100 is T00.

The geological study done in the affected area allows us to classify the type of soil as tolerable (0).

Given that the intention is to obtain an E3 esplanade above the tolerable ground, from the two options given in the existing norms, it is decided to arrange 30 cm of stabilized S-EST3 in situ ground above the 30 cm of selected ground.

Taking into account that the type of heavy traffic is T00 and that the esplanade will be E3, from all the sections defined in the norm 6.1-IC, it is considered as the most suitable one the 0031 section, for its low degree of difficulty execution and because the artificial sand used implies a better finishing. Moreover, it maintains the continuity with the firm defined for Street 100 in the “Urbanization Project of the Street 100”.

In those vials placed on the existing firm, the milling of the surface layer is executed and a posterior regularization is done until reaching the projected flush.

Table 181. Firm section in the vials (*source: Esteyco)*

Firm (section 0031)	
Asphalt hot mix	35 cm
Discontinuous asphalt mix AC16 surf BM-3c D	5 cm
Modified adhesion irrigation ECR-2d-m (minimum amount 500 g/m^2)	
Semi dense asphalt mix AC22 bin B60/70 S	8 cm
Adhesion irrigation ECR-1d (minimum amount 500 g/m^2)	
Semi dense asphalt mix AC32 bin B60/70 G	10 cm
Adhesion irrigation ECR-1d (minimum amount 500 g/m^2)	
Semi dense asphalt mix AC32 bin B60/70 G	12 cm
Primer irrigation ECI (minimum amount 1.000 g/m^2)	
Base of artificial sand	25 cm
Cured irrigation ECR-1d with a minimum binder amount of 500 g/m^2	
Esplanade type E-3	

It must be marked that the dense asphalt mix AC16 surf D was selected as a surface layer, contrary to what the norm recommends for heavy traffic type T00. That is because, as Port of Barcelona is in the rainfall zone 5, defined dry, and as there is slow traffic and heavy truck maneuvering, heavy loads will be applied on the firm top layer, and in consequence a draining asphalt mix does not ensure the durability required. Therefore, an AC16 surf D asphalt mix was chosen because it satisfies the necessary requirements of resistance and durability, and at the same time is not very expensive.

3.6.2. Sidewalks and bike path

For the dimensioning of the sidewalks and the bike path, it was decided to use the already existing typology, following at the same time the reference rules for the urbanization works in the service area of Port of Barcelona.

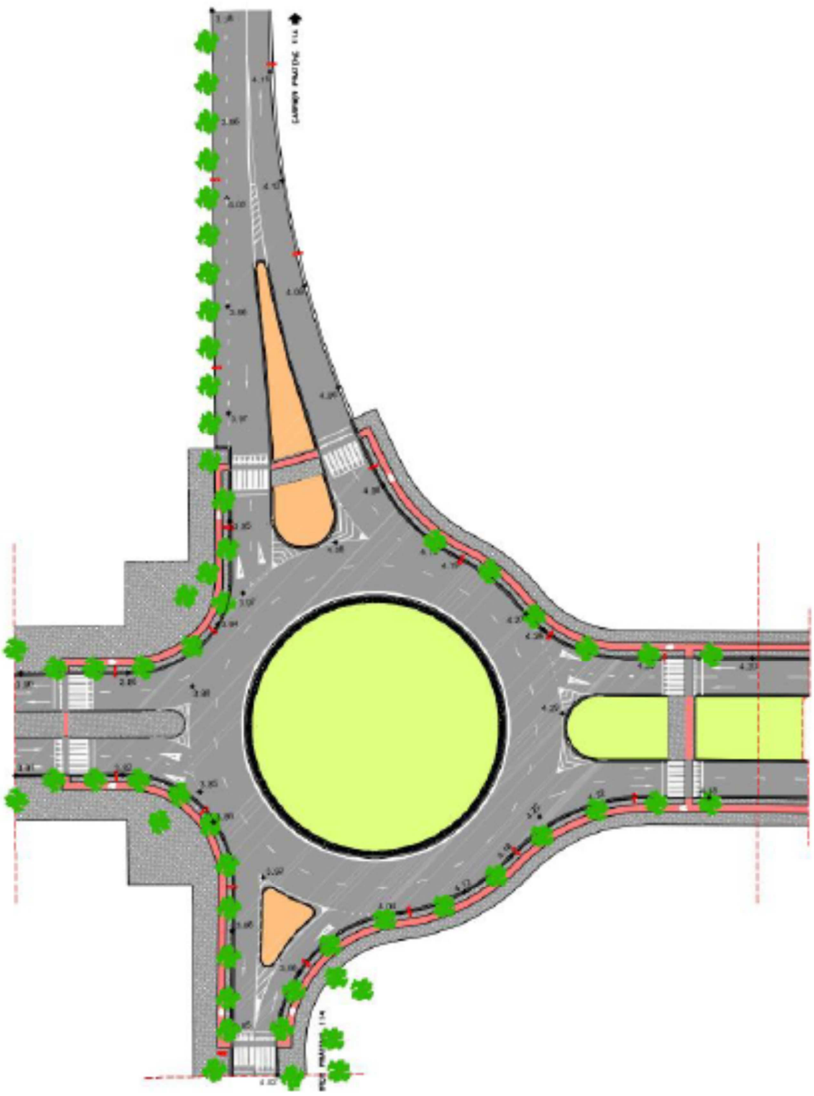


Figure 130. Sidewalks and bike path dimensioning (*source: Esteyco)*

It will be composed of an hydraulic tile of 0,20 x 0,20 size of 4 tablets and 4 cm thickness above a 3 cm mortar layer. Below them, a 15 cm fck 15 N/mm^2 concrete layer will be placed for a leveling and cleaning purpose above a 20 cm artificial gravel layer (esplanade). Below the artificial gravel, a 40 cm selected soil layer will be placed.

The curb to be placed will be made by a BR1 type 30 x 20 cm precast concrete in horizontal position, in order to give continuity to the existing one in L'Estany del Port Avenue. It will be a T-3 mountable curb inside the traffic roundabout and type T2 in the Streets 100 and 114, in order to be homogeneous with the current curb.

3.6.3. Roundabout interior

Inside the traffic roundabout, next to the T-3 mountable curb, a 12x12x8 cm concrete paver pavement will be placed in the perimeter in a 1,0 m band. It will be placed above river sand and HM-15 concrete slab, top-dressed with sand, as in the following Figure 131.

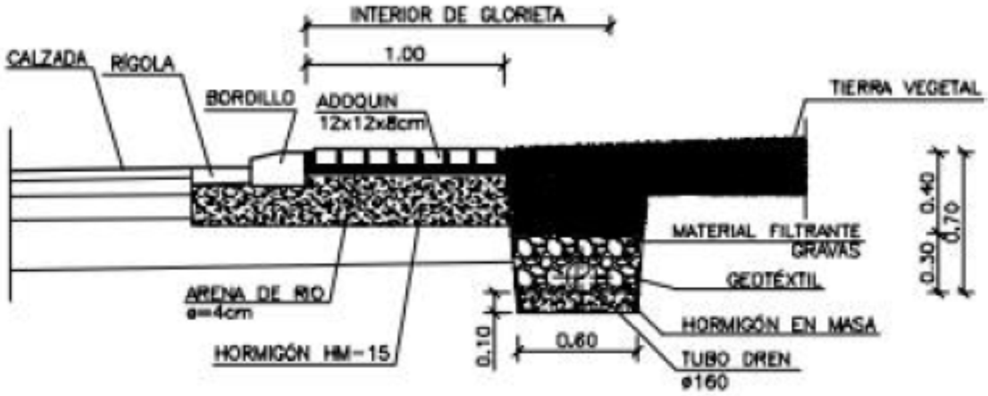


Figure 131. Roundabout interior (*source: Esteyco)*

Aiming to integrate decoratively the traffic roundabout, the walkable area of the access to the existing storm water bi cellular manifold will be built by a pavement made by turfed lattice pieces above an HM-15 concrete layer, everything filled with topsoil.

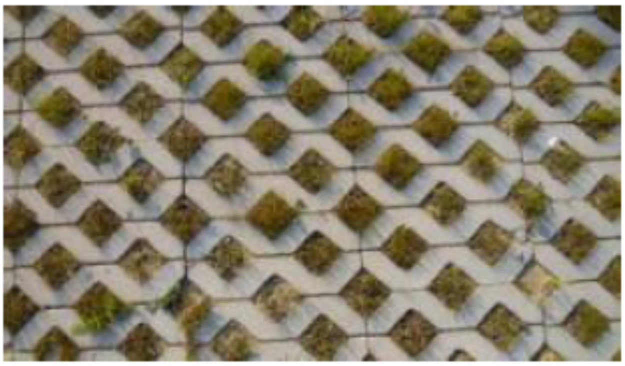


Figure 132. Walkable area of the access to the existing storm water bi cellular manifold (*source: Esteyco)*

3.7. Drainage and sanitation

In order to solve and ensure the drainage of the runoff in the new urbanization area, a network of inlets that substitutes or enlarges the existing ones was designed, and they were correctly adjusted in order to connect with the existing networks.

For the design of the drainage network, the criteria described by the City Council of El Prat de Llobregat and by the public company Clavegueram de Barcelona, S.A. (CLABSA) was followed, because these were the followed ones in the design of L'Estany del Port Avenue.

3.7.1. Background

For the development of the Project, apart from the data collection and the field works executed, information collected in the following Projects was taken into account:

- *Modification number 2 of the canalization project of the Llobregat River from The Mercabarna Bridge to the Sea* (Agència Catalana de l'Aigua, May 2004). Concerning the scope of the current project, in the existing intersection of Streets 114 and L'Estany del Port Avenue (old Street 100), runs the interceptor sewer projected from the Avenue, and it is composed by a bi cellular concrete drawer of dimensions 2,00 x 3,50 x 1,5 m.

  All the runoff collected by the projected drainage system will be connected to this bi cellular concrete drawer, in order to be able to analyze in the appropriate purifying plant the water collected during the first 10 minutes of rainfall along all the scope of the project.

- *As-Built Project of the urbanization and extension of the logistics zone of Port of Barcelona, phases 1 and 2* (COPISA, March 2003 and October 2005). **The actions described in the As-Built do not belong to the strict scope of the current project**. However, in this project is stated (as a connection network) the frame system belonging to the City Council of El Prat.

- *As-Built of the reshuffle project of the sewer system of the Industrial area of El Prat de Llobregat* (EGI, Enginyeria I Gestió d'Infraestructures, December 2005). This project was written after a request from the City Council of El Prat de Llobregat. The sewerage network in the Street 114 is formed by a unicellular frame of 2,50 m base and 1,50 m height, from which the inlets located every 20 m in the northeast sidewalk of the Street 114 are successively connected. This network will be totally maintained, except the two inlets located at the southwest part that are affected both by the new flush and the new order.

- *Reshuffling project of Streets 110/114 of the Pratec Industrial area in the perimeter zones of the Baix Llobregat purifying plant at El Prat de Llobregat* (EGI, October 2007). The information extracted from this project gives useful data with respect to the connection to the storm water network projected at the South-West part of the Street 100. After the topographic map and the field works that were carried out, it was checked that the wells 2-1 were alienated.

- *Urbanization project of Street 100* (Esteyco, March 2009). On March 2009, the Port Authority of Barcelona requested Esteyco the adaptation of the urbanization project of

Street 100 to the new service requirements and geometric actions that would allow the Street to fit with the new access road network to the new terminals.

3.7.2. Climatology and pluviometry

For the design and justification of the drainage network, the recommendations from CLABSA have been followed, using therefore the designed rainfall defined in the Special Sewer Plan of Barcelona with a 10 years return period.

The histogram was done by the alternating blocks system after determining the IDF curves (intensity – duration – frequency), attached here:

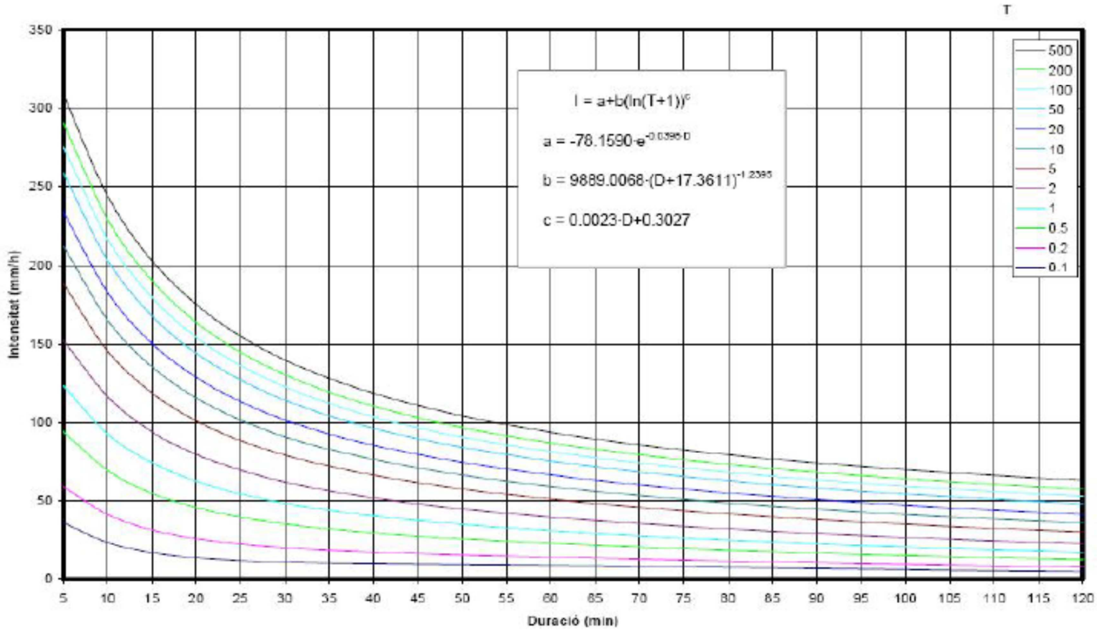


Figure 133. Barcelona – Fabra IDF curve (1927-1993 series) (*source: Esteyco)*

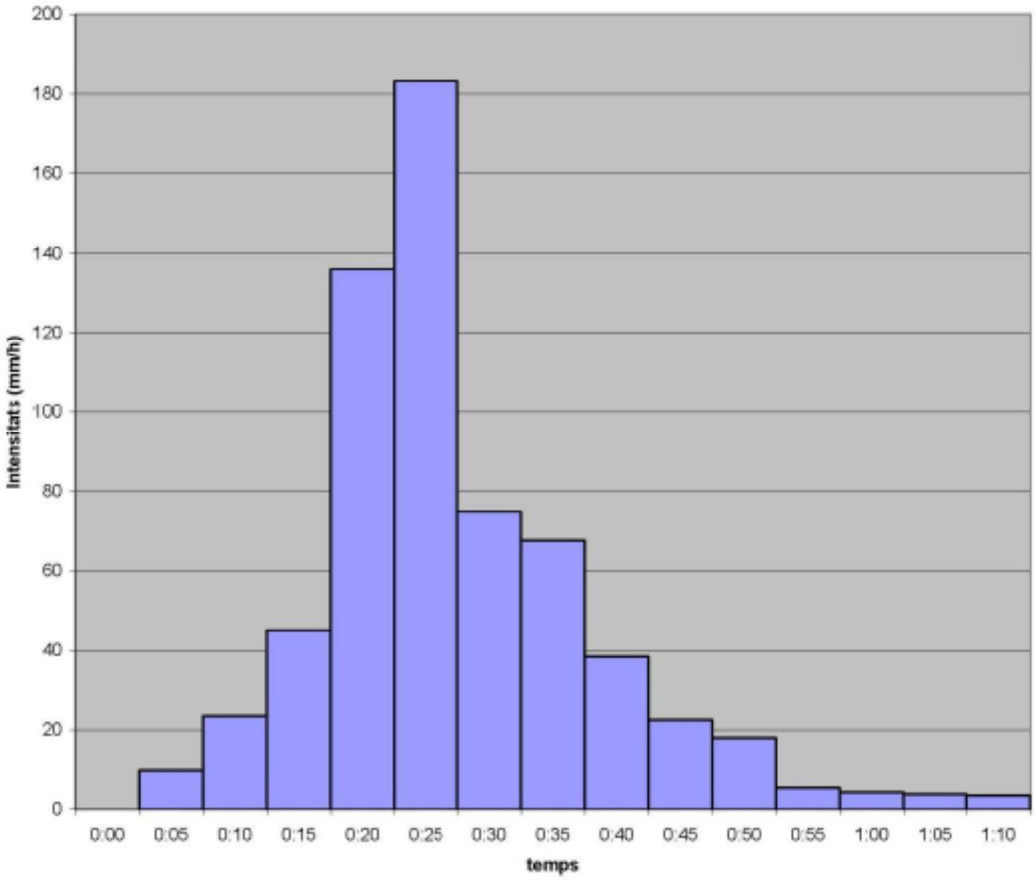


Figure 134. Designed rainfall for a 10 years return period (*source: Esteyco)*

D(min	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120
T(any																								
0.1	36.3	23.5	17.0	13.6	11.7	10.7	10.2	9.8	9.5	9.3	9.0	8.7	8.4	8.1	7.8	7.5	7.2	6.8	6.5	6.2	5.9	5.6	5.3	5.0
0.2	59.0	41.4	31.7	26.0	22.5	20.2	18.6	17.3	16.3	15.5	14.7	14.0	13.4	12.7	12.1	11.5	10.9	10.4	9.9	9.4	8.9	8.4	8.0	7.6
0.5	94.1	69.3	54.8	45.7	39.7	35.4	32.2	29.7	27.7	25.9	24.4	23.0	21.8	20.6	19.6	18.6	17.6	16.7	15.9	15.1	14.4	13.7	13.1	12.5
1	123.1	92.6	74.3	62.4	54.3	48.5	44.0	40.5	37.6	35.1	33.0	31.1	29.4	27.8	26.4	25.1	23.9	22.7	21.6	20.6	19.7	18.8	18.0	17.2
2	152.3	116.1	94.0	79.5	69.4	62.0	56.3	51.8	48.1	44.9	42.2	39.7	37.6	35.6	33.9	32.2	30.7	29.3	28.0	26.8	25.7	24.6	23.6	22.7
5	188.2	145.2	118.6	100.9	88.4	79.1	71.9	66.2	61.5	57.5	54.1	51.1	48.4	46.0	43.8	41.8	39.9	38.2	36.7	35.2	33.9	32.6	31.4	30.4
10	212.4	164.9	135.3	115.4	101.3	90.9	82.8	76.3	70.9	66.4	62.5	59.1	56.0	53.3	50.9	48.6	46.6	44.7	43.0	41.4	39.9	38.5	37.2	36.1
20	234.0	182.5	150.2	128.5	113.1	101.5	92.6	85.4	79.5	74.5	70.2	66.4	63.1	60.1	57.5	55.0	52.8	50.8	48.9	47.2	45.6	44.1	42.8	41.5
50	258.9	202.9	167.7	143.8	126.8	114.0	104.1	96.1	89.6	84.1	79.3	75.2	71.6	68.3	65.4	62.8	60.4	58.2	56.2	54.3	52.6	51.0	49.6	48.2
100	275.6	216.6	179.4	154.1	136.0	122.5	111.9	103.5	96.5	90.6	85.6	81.2	77.4	74.0	70.9	68.1	65.6	63.3	61.2	59.3	57.5	55.9	54.4	53.0
200	290.8	229.1	190.0	163.5	144.5	130.2	119.1	110.2	102.9	96.7	91.4	86.8	82.8	79.2	76.0	73.1	70.5	68.1	65.9	64.0	62.1	60.4	58.9	57.5
500	308.9	244.0	202.9	174.9	154.7	139.6	127.8	118.4	110.6	104.1	98.5	93.7	89.4	85.6	82.3	79.3	76.5	74.1	71.8	69.7	67.9	66.1	64.5	63.1

Figure 135. IDF curves values for Barcelona (*source: Esteyco)*

As it can be observed, for a 10 years return period, the rainfall intensity of a 5 minutes duration is 212,40 mm/h. This value is will be used to calculate the volume of water circulating in the new manifold network.

3.7.3. Sewer network design

For the sewer network design, the following criteria were taken into account:

- A minimum slope of 0,3% due to the possible limitations of the existing services, and velocities between 0,5 and 6 m/s (CLABSA requirements).

- PVC tubes will be used, and they will be covered by concrete following CLABSA requirements.

- An inlet will be placed at least every 180 m^2 of drainage area. The dimensions of the inlet will be 70x30 cm.

- The type of inlet to be placed will be Barcelona1. The maximum distance between two consecutive inlets will be 15 m. Two consecutive inlets will be able to be connected by tubes of minimum 300 mm diameter and 3% longitudinal slope.

- In some cases, such us in the lowest points of the outline, double inlets will be placed in order to improve their drainage capacity.

- The connections between inlets and manifolds will be done directly to the base of the manifold, without the necessity of building a well. These connections will be carried out by 500 mm minimum diameter tubes, and on the same way of the water flow.

- In the green zone near the traffic roundabout, it is expected to collect the rainfall and irrigation water by a sub drainage network, in order to avoid damages to the new vial's esplanade due to the water infiltration. These sub drainages will have a 160 mm diameter, and they will be wrapped in a package of gravels and protected by a geotextile material that will be connected to a 300 mm diameter manifold, that will transport the water collected to the existing interceptor.

- The manholes to be built will have 1 m diameter with eccentric conical reductions in order to place the 65 x 60 cm covers. These covers will be alienated with the center of the traffic lane, avoiding vehicles to pass over them. Therefore, the covers' axes will always coincide with the traffic lane axis.

3.8. Installations

The installations that will be built in the affected area are:

- Lighting network.

- Telecommunications network.

3.8.1. Lighting network

The designed lighting network is composed by the existing command center, from which some lighting circuits are derived (L-1 to L-4). Initially, the possibility of connecting the projected lighting to these circuits was considered. However, the high voltage drops produced and the necessity of modifying the existing cables' section in the already executed stretches, forced to discard this option. It was preferred then to use the reserve circuits L-5 and L-6, available in the existing command center, in order to carry out the connection of the projected lighting.

The chosen outline is a consequence of the necessity to connect all the spotlights to this network, trying to make the path as minimum as possible, and taking into account the other installations operating in each place.

The lighting is planned to be executed by 9 m height lampposts, with a 40,0 m distance separation between them, and with a luminaire power of 250 W. All this in order to satisfy all the restrictions of the new norm (energetic optimization).

When selecting the lighting level, the singular characteristics of the selected stretch analyzed were taken into account. As said before, the public lighting design was done following the indications of the norms referring to the urbanization works inside the service area of Port of Barcelona, which specify the following lighting level for roadways (hypothesis: lighting class ME_1 comparable to CE_1):

Parameter	**Class CE_1**
Average luminance E_m (lux)	30
Minimum luminance (lux)	12-15
Average uniformity coefficient U_m	0,40-0,50

Projected luminaries

Concerning the luminaries' election, their location was taken into account in order to respect the lighting requirements. The selected luminary is the Euro-7 type, which presents the following characteristics:

- High light output (a high percentage of the flux given by the lamp is reflected on the roadway).
- Good photometric curve (the flux is distributed properly).
- Good dazzling control.
- Mechanical and electric properties that ensure a medium – long term life of the installation.

- Resistant to a possible vandalism.

The type of lamppost used will be the type NAV-T 250 W. The lighting characteristics are the following:

Roadway (flux)		
Average	**Minimum**	**Maximum**
37,04	19,00	73,51

Civil works

- **Canalizations**. The lighting canalizations will be formed by 4 tubes of 110 mm diameter that will be registered in the adequate manholes. These canalizations will be concreted with HM-25 concrete for a better protection.

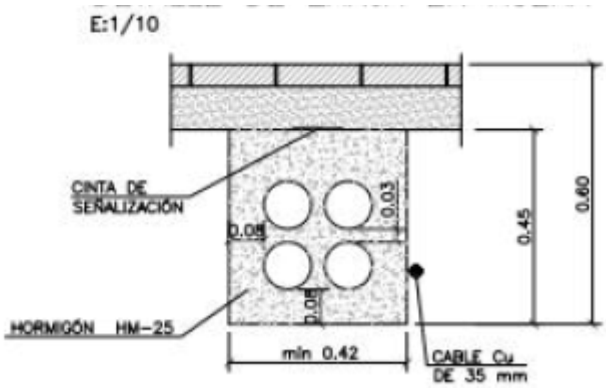


Figure 136. Detailed ditch on sidewalk (*source: Esteyco)*

The execution of the prism will be done as following: once excavated the prism ditch, a cleaning concrete layer will be executed. The tubes will be placed on this layer and separators between tubes will be installed to ensure that concrete penetrates in all the holes, with a minimum concrete covering of 0,03 m between tubes and 0,08 m with respect to the bottom of the excavation and gables.

- **Manholes**. Their interior dimensions will be 35 x 35 cm (frame dimensions 40 x 40 cm), with a maximum depth of 60 cm. For depths larger than 60 cm, as well as in the intersections, points and manholes located in roadways, the interior dimensions of the manholes will be 55 x 55 cm (frame dimensions 60 x 60 cm).

  Manholes can be made by prefabricated concrete or by solid brick. In both cases, the existing space between the excavation and the manholes' walls will be filled completely by HM-25 concrete. A manhole will be placed next to each spotlight.

- **Lighting columns**. The lighting columns projected to the vials will have a truncated shape of 9 m height, a galvanized steel sheet of at least 3 mm thickness and a covering of 450 g/m^2 of Zinc, tip diameter of 60 mm, and they will provide a flushed registration door interiorly reinforced.

Electric installation

- **Cabling**. The cables will be RV-K 0,6/1 KV in all the sections of the underground installation. They have been calculated in order the voltage drop not to be higher than 3% of the admitted by the luminaries components and 5% of the admitted by the rest of the components (as provided by REBT).

- **Scorecard and protection**. The scorecard used will be the existing one (Port Authority of Barcelona), located in L'Estany del Port Avenue (old Street 100). This scorecard has two reserve circuits (C-5 and C-6), and a maximum admissible power of 13,85 kW. The current installed power is 6.900 W. It allows serving the demanded power of 4.000 W.

Energy qualification of the installation

- **Energetic efficiency**. The energetic efficiency of an outdoors lighting installation is defined as the relation between the product of the illuminated surface and the average luminance in service divided by the total active power installed:

$$\boldsymbol{\varepsilon = (S \times E_M) / P}$$

Where:

- o ε = Energetic efficiency of the outdoors lighting installation (m^2 x lux / W).
- o E_M = Average luminance in service of the installation, considering the maintenance (lux).
- o S = Reference roadway illuminated surface (m^2).
- o P = Total active installed power (W).

The minimum requirements established by the real decree 1890/2008 on November 14th 2008 are used for the functional and ambient vial lighting and are determined by

ITC-EA-01. The obtained results in the projected installation are acceptable according to the real decree 1890/2008, and are the following:

Studied area	**Illuminated surface (m^2)**	**E_M (lux)**	**Total active installed power (W)**	**Ɛ**
Traffic roundabout	3.060	37,04	4.000	28,33

- **Energetic qualification**. The outdoors lighting installations, except Christmas lighting and illuminated signs, will be qualified according to their energetic efficiency index (IƐ). IƐ is defined as the quotient between the energetic efficiency of the installation (Ɛ) and the reference energetic efficiency (ƐR), which is a function of the average luminance in service projected. ƐR is indicated in the real decree 1890/2008, ITC-EA-01. The projected installation has de following energetic qualification:

Studied area	**IƐ**	**Energetic qualification**
Traffic roundabout	2,17	A

3.8.2. Telecommunications network

The projected actions pretend to allow in the future the closure of the Port Authority of Barcelona telecommunications network, once the extension works of Street 114 are over.

The projected action will consist basically in the execution of a telecommunications prism of 9 conduits, including in the last 3 tritubes ϕ 40 PE, that once intersects l'Estany del Port Avenue, discourses through the sidewalk until the connection with Street 114 with the following canalization cross section:

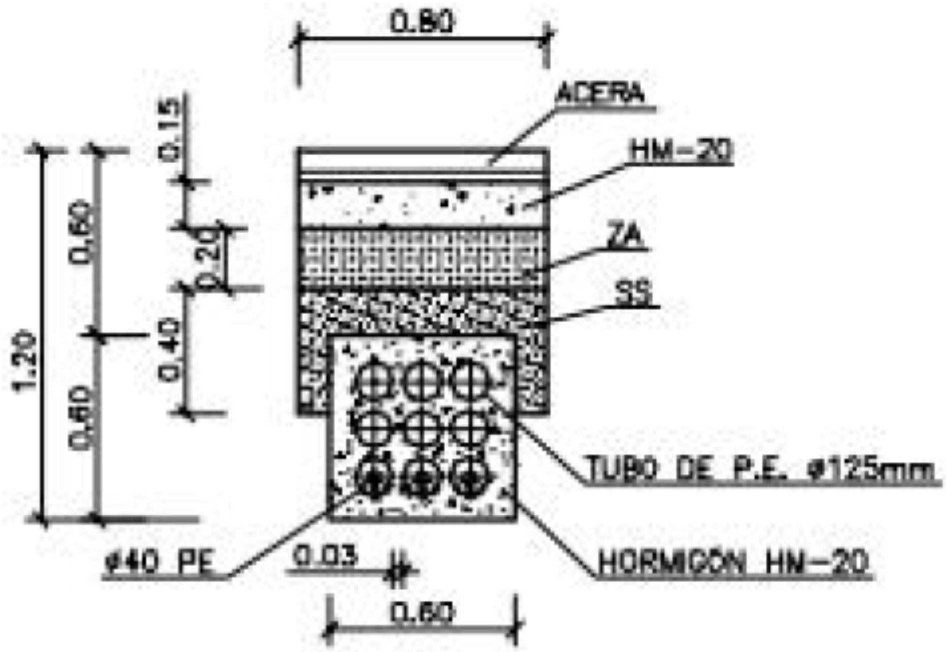


Figure 137. Canalization cross section of the telecommunications prism between L'Estany del Port Avenue and Street 114 (*source: Esteyco)*

The telecommunications network will provide manholes every 50,0 m and wherever there is a reversal point. These manholes will be made by prefabricated concrete or solid brick of dimensions 140 x 70 x 1,0 m approximately.

3.9. Affected services

For the identification of the existing services, information about the installations from the Port Authority of Barcelona was provided. At the same time, consultations to the companies operating in the port were carried out. The following companies were consulted: Empresa Metropolitana de Sanejament, S.A. – EMSSA., City Council of El Prat de Llobregat, FECSA-ENDESA, GAS NATURAL, S.D.G., TELEFÓNICA, S.A.U., Aigües del Prat.

The research about the definition of the existing installations and services consisted basically in:

- Topographic map and inspection on site of all the visible installations and services, identifying each type of service and the possible owning company.

- Contrasting the field data collected with the available information from the Port Authority of Barcelona.

- Request to the affected companies about the recent available data of the services located in the area affected by the current project.

- Proposal of the temporary deviations, protections and/or replenishments to the affected companies.

- Contacting the affected companies, requesting the respective proposal of replenishment and/or protection.

Now a description of the different service networks, the respective type of affectation and the replenishment proposal is done.

3.9.1. Sewer network

Currently, there exist two sewer networks in the area affected by the project and in the streets that connect with it, belonging to the City Council of El Prat de Llobregat and to “Entitat Metropolitana de Serveis Hidràulics I Tractament de Residus (EMSHTR)”, all managed by “Empresa Metropolitana de Sanejament (EMSSA)”.

Storm water network

In the area affected by the project, we first encounter a manifold which discourse through Street 114, and consists in a drawer of dimensions 2,50 x 1,50 m. This manifold collects the water from the inlets placed on the vial, and evacuates it to the manifold discoursing through L’Estany del Port Avenue, which consists of two bi cellular drawers of dimensions 2,0 x 3,5 x 1,5 m, belonging to the City Council of El Prat.

These manifolds are located around 50 cm below the ground level, which does not differ practically from the projected ones. This fact conditions significantly the potential installation of services in the area due to the possible intersections with them.

The only affectation considered about the manifold is the one produced near the access of machinery to the bi cellular drawer that discourses through L’Estany del Port Avenue. In this place heavy vehicles drive over the existing manifold cover, therefore producing the deformation of the metal fence and the sinking of some of the concrete slabs.

The actions projected will modify slightly the elevation of the ground at this point, and in consequence the metal fence and the concrete slabs will not be affected by the heavy vehicles driving over them as much as before. In order to avoid future possible problems similar to this one, it is decided that the heavy vehicles will go through the traffic roundabout interior, avoiding them to drive over the manifold and also avoiding them to create any inconvenience when carrying out the maintenance works in the manifold.

Sewage network

To the sewage network belongs the interceptor of Street A – type NT1715 –, belonging to the "Entitat Metropolitana de Serveis Hidràulics I Tractament de Residus (EMSHTR)". The affected section discourses through the future extension area of Street 114 and through L'Estany del Port Avenue until its connection to the treatment plant.

This manifold is always below the lower bound of the esplanade, therefore it will not be affected by the construction works. The only thing that must be taken into account is the alienation of the covers with the new flush.

3.9.2. Water supply network

In the area affected by the project there exists a water supply network, belonging to "Aigües del Prat".

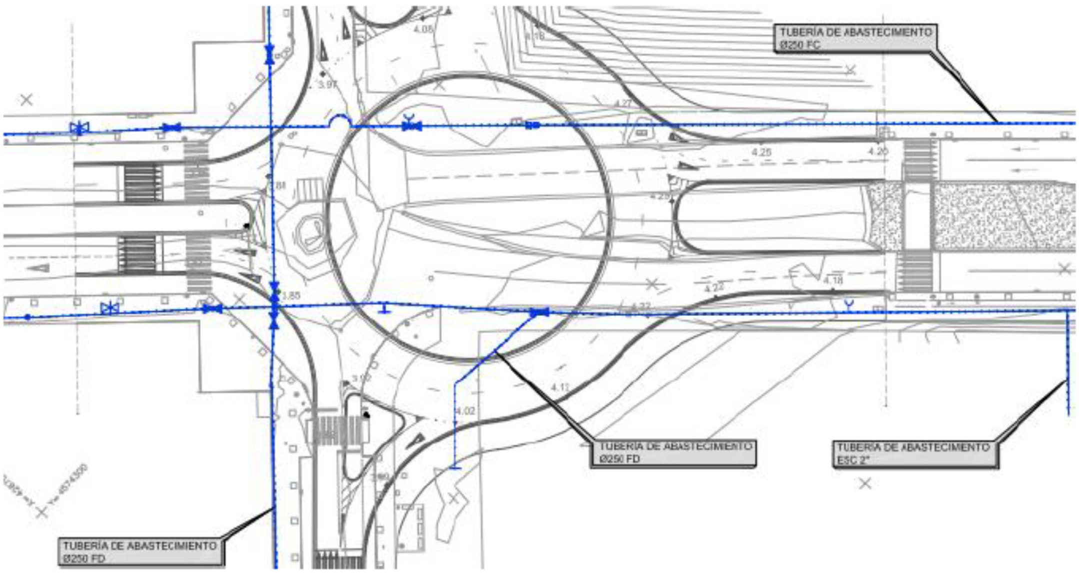


Figure 138. Scheme of the existing water supply network (*source: Esteyco)*

On the one hand there are two supply lines that discourse through both edges of L'Estany del Port Avenue. They are formed by a ϕ250 mm melting pipeline on the right side of the Avenue and a ϕ200 mm polyethylene pipeline on the left side. On the other hand, another ϕ250 mm melting pipeline discourses through the existing sidewalk of Street 114.

The projected actions do not affect directly any of these supply lines, but they do affect the location of their mechanical equipment (suckers, shutoff valves, etc.). The replacement proposal of all this mechanical equipment has been done by “Aigües del Prat” and consists basically in the installation of ϕ250 mm gate valves on the sidewalks, an underground ϕ100 mm hydrant and a 2’’ sucker for the ϕ250 mm supply lines.

3.9.3. Regenerated water network

In the area affected by the project there exist two regenerated water lines managed by the “Empresa Metropolitana de Sanejament EMSSA”.

From the tertiary treatment zone of the purifying plant to the Street 114 discourse a ϕ400 mm line that transports regenerated water to the Montjuïc Park in Barcelona. In almost all its path it passes by the interior of the purifying plant parcel until reaching the existing electrical panel located next to its entrance. From this place the line is located below the existing sidewalk at L’Estany del Port Avenue until reaching Street 114. Before reaching Street 114, the line affects the scope of the project. However, the upper bound of the pipeline is at 2,20 m, still much lower than the lower bound of the esplanade to execute, and therefore any affectation to the pipeline is expected.

In addition, in order to avoid possible affectations to one of the manifolds existing in the Street 114, a connection branch from the traffic roundabout to the Street 114 was projected in order this manifold to be located outside the roadway.

The other existing regenerated water line consists in a ϕ500 mm line discoursing through Street 114. This line aims to feed some injection wells that contribute with water to the Llobregat River in order to decrease the intrusion of Sea water to it.

This line discourses at a depth higher than 2,0 m, and none of the projected actions affect it. Moreover, the connection branch from the traffic roundabout to the Street 114 was projected so the manifold of the existing injection well was located in the middle zone of the roadway (avoiding its affectation).

3.9.4. Gas Natural

A high pressure gas conduit belonging to Gas Natural discourses through the Sea side of Street 114.

The projected action will affect the canalization and its signalling, so it will be necessary to replace it. The replacement proposal of all the necessary mechanical works was done by Gas Natural. The solution consists basically in:

- Installation of a new DN-6” MOP-16 bar steel pipe branch of 53,0 m.

- 31,0 m protection of the existing conduit by DN-10” medium canes of 6,35 mm thickness.

- Protection of the steel pipe branch section on the existing manifold section by a DN-10” steel protection tube of 6,35 mm thickness and a concrete slab.

- Protection of the opencast steel pipe branch section by a DN-10” steel protection tube of 6,35 mm thickness and 25,0 m long.

- Execution of 2 provisional steel DN-6” MOP-16 bar by-passes of 13,0 and 17,0 m long.

3.9.5. Fecsa-Endesa

In the area affected by the project, as well as in the connection streets to it, there exist different underground canalizations of MV and LV belonging to Fecsa-Endesa. The following figure shows the existing MV and LV network in the area affected by the project:

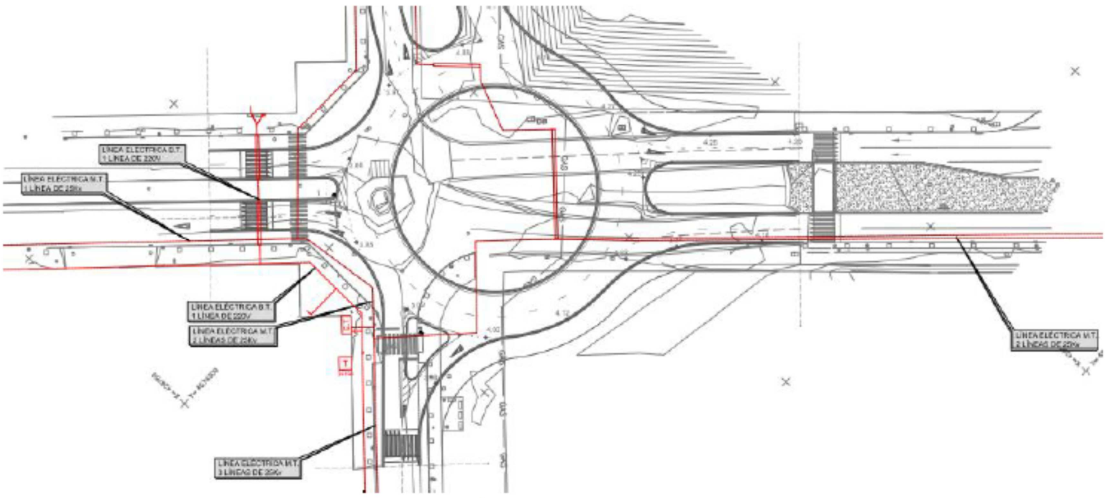


Figure 139. Existing MV and LV network belonging to Fecsa-Endesa in the area affected by the project (*source: Esteyco)*

The projected actions will affect the underground canalizations of MV belonging to Fecsa-Endesa. Therefore, it will be necessary to replace them.

The replacement proposal was done by Fecsa-Endesa. The solution consists basically in a deviated branch of the MV canalizations affected by the project. In this replacement proposal, together with its economic valuation, it is planned to carry out some civil works (canalizations) that will be done by the main contractor. Therefore, the contractor will execute the crossing opencast expected actions in L'Estany del Port Avenue and in the Street 114.

In the executed crossing at L'Estany del Port Avenue, it will be executed as well a 3,0 m width and 1,20 m depth canalization. This canalization includes the execution of an HM-20 concrete prism with 8 PVC corrugated tubes, an 8 mm thickness steel plate, a PVC signalling sheet and the replacement of the existing pavement.

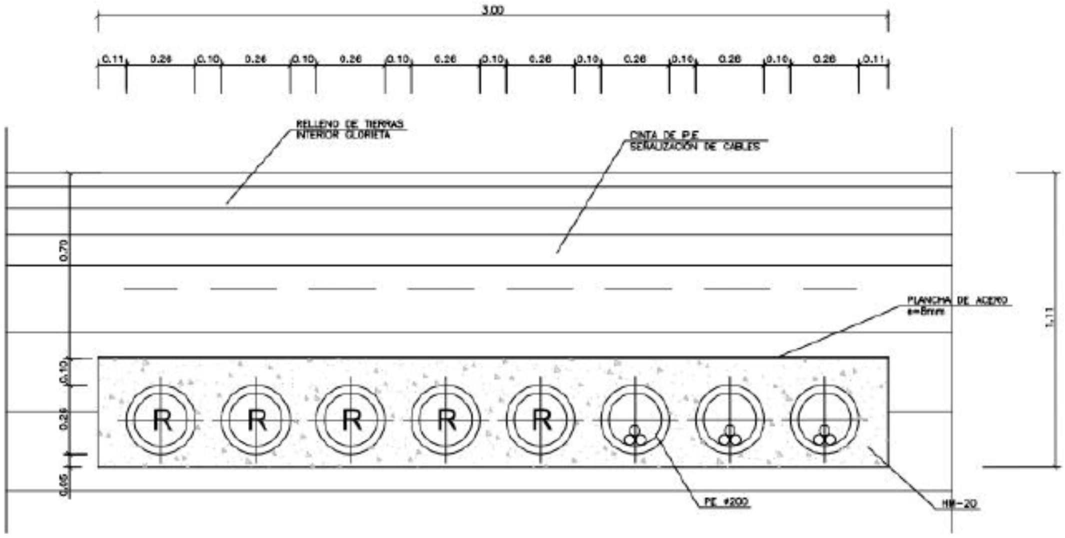


Figure 140. Prism to execute in L'Estany del Port Avenue (*source: Esteyco)*

In the executed crossing in the Street 114, it will be executed as well a 1,60 m width and 1,20 m depth canalization. This canalization includes the execution of an HM-20 concrete prism with 4 PVC corrugated tubes, an 8 mm thickness steel plate, a PVC signalling sheet and the replacement of the existing pavement.

3.9.6. Telefónica

In the area affected by the project, there exist some underground telecommunications canalizations and an aerial telephone line belonging to Telefónica. These canalizations discourse through the left margin of L'Estany del Port Avenue and through the existing sidewalk in the Street 114. Simultaneously, an aerial telephone conduit on wood supports discourses through the Sea side of Street 114.

The projected actions will affect the 8 conduit canalization that discourses through L'Estany del Port Avenue in its crossing with Street 114, the aerial telephone conduit and the 4 conduit prism that discourses in parallel to Street 114.

The replacement proposal was done by Telefónica. The solution consists basically in the underground relocation of the aerial telephone conduit and in the deviation of the underground affected canalizations, with all the necessary modifications of the existing manifolds and recording chambers.

3.10. Irrigation and gardening

3.10.1. Irrigation network

In the irrigation network of the current project there exist two different kinds of irrigation: sprinkling irrigation and dripping trees irrigation.

The irrigation hydraulic installations will be made by low density polyethylene pipelines for diameters smaller than 75 mm and by low or medium density polyethylene pipelines for diameters smaller than 90 mm. All the conduits and installation accessories will use a minimum working pressure of 10 atm., and according to the existing official norms.

The hydraulic conduits will discourse preferably through land areas, avoiding as much as possible paved areas.

The irrigation network to be executed is projected as an extension of the existing one in L'Estany del Port Avenue. Therefore, the secondary dripping irrigation network for the road trees in the existing sidewalks will be extended. On the other hand, both in the middle of L'Estany del Port Avenue and in the traffic roundabout, an extension of the primary and secondary networks is projected in order to feed the existing hydrants and sprinklers.

To sum up, the projected irrigation network is divided into different primary and/or secondary networks, which will be described in the following chapters.

Primary irrigation network

This network starts from the existing manifold at the gardened middle part of L'Estany del Port Avenue and brings the irrigation water to the existing sectorial by-passes of the different secondary networks. In parallel to this network, a PE 60 mm conduit carrying the necessary electric cables (1 KV 4 x 2,5 mm^2 cable) will discourse in order to drive all the sectorial by-passes' solenoids of the existing secondary networks.

This primary irrigation network will be done by a PE BD pipeline of diameter 75 mm and nominal pressure 10 atm.

The existing hydrants hang from this primary irrigation network. These hydrants are bayonet quick coupling, type SR-2310 and SR-2350, bought from Euro-Rain or similar. They will be fed exclusively by drinking water. The hydrants will be placed in land accessible areas for the maintenance staff, and they are separated between them a maximum distance of 50 m. This distance will be shorter wherever there are difficulties and it will not be taken into account wherever irrigation is no needed through a hydrant.

This primary hydrant network will be done by a PE BD pipeline of diameter 50 mm and nominal pressure 10 atm.

Secondary sprinkling irrigation networks

These networks start from the different sectorial “by-passes” distributed through the project area. Through these networks all the land areas with grass or similar flora less than 20 cm height and more than 4 m width will be irrigated. These networks’ design was done by zoning the sprinkling irrigation surfaces as a function of the counter capacity and trying to reduce as much as possible the number and length of necessary tubes.

This secondary sprinkling irrigation network will be done by a PE BD pipeline of diameter 50 mm and nominal pressure 10 atm. The branches connecting this secondary network with the sprinklers will be done by a PE BD pipeline of diameter 25 mm and nominal pressure 10 atm.

The installed sprinklers will be the PGP model from the brand Hunter or similar. The radius and angle of inclination will be fixed depending on each particular case, having in total a maximum coverage radius of 10,4 m.

Secondary dripping trees irrigation networks

These networks start from the different sectorial “by-passes” distributed through the project area. Through these networks all the trees located in paved areas will be irrigated by drip rings. The trees located in green areas will be irrigated by the sprinkling/diffusion irrigation networks or by the land areas dripping irrigation networks.

The drip rings will be open with 7 droppers of approximately 3,5 l/h inserted every 30 cm. They will be protected by a drain tube of diameter 50 mm at an approximately 20 cm depth.

These networks are independent from the sprinkling irrigation networks. Therefore, the consumption of water of these networks will be much less than the sprinkling irrigation networks.

3.10.2. Gardening

The new wooded, alignments and species are defined as a function of the design criteria for the public area where the project is developed.

The existing alignments will be extended in L'Estany del Port Avenue, where the plantation of the "Populus Nigra" is suggested. These trees will be planted with a portage of 2 m height so their adaptation to the environment and their success is assured.

The type of grass to be planted, following the "Parcs i Jardins" criteria, will be the C-4. This type of grass has the quality to improve its resistance to droughts and, therefore, less irrigation water will be required.

3.11. Waste management

The research about the waste management of the current project was done following the Royal Decree 105/2008 (1st of February), that establishes and regulates the production and management of construction and demolition wastes.

Out of the numerous duties imposed to the producer, it must be highlighted the necessity of including in the construction project a research about the waste management. This research must follow the indications of the article 4.1.a) of the Royal Decree 105/2008, including the following:

- An estimation of the quantity – given in tonnes and m^3 – of the construction and demolition wastes generated, and coded according to the European list published MAM/304/2002 (8th of February), which shows the valorisation operations, the wastes elimination and the European wastes list.

- The wastes prevention measures in the current project.

- The reutilisation, valorisation or elimination operations of the wastes generated.

- The measures taken to separate adequately the wastes during the works. In particular, for their accomplishment from the wastes' owner point of view.

- The maps of the expected installations for the storage, holding, separating and other management operations affecting the construction and demolition wastes in the project area. Afterwards, these maps can be adapted to the particular features of the works done and its execution systems if approved by the faculty direction.

- The particular requirements affecting the current project given in the statement of technical requirements, related to the storage, holding, separation and other management operations affecting the construction and demolition wastes in the project area.

- A valorisation of the expected cost concerning the construction and demolition wastes management. This cost will be part of the project's budget.

The wastes producer will attempt to accomplish the specific existing norms, promoting the prevention of the construction wastes, their reutilisation, recycling and other ways of valorisation, ensuring always their adequate treatment in order to be sure about the sustainable development of the construction works.

The contractor will submit to the promoter a Management Plan for the construction and demolition wastes generated, according to the content defined in the articles 4.1 and 5 of the Royal Decree 105/2008. This Plan will be based on the descriptions and contents of the research about the wastes management of the current project, and it will have to be approved by the project manager and accepted by the promoter. Once accepted, it will become part of the construction contract documents.

In case the contractor of the construction and demolition wastes is not able to manage them by itself, it will have to submit them to an authorized manager with the corresponding documentation, certificates and obligations determined in the article 5.3 of the Royal Decree 105/2008.

3.12. Enclosure

Depending on its location, the following enclosure types are projected:

- Enclosure in purifying plants areas. The existing enclosure will be replaced by a fax de Rivisa fence 2,0 m height.

- Enclosure in ZAL parcels. A fence similar to the existing one and consisting in a simple torsion galvanized metal fabric 2,0 m height and 50 mm mesh size will be placed.

3.13. Prices justification

GISA Prices Base for Civil Works (2010) was used to elaborate the prices justification of the current project. However, it is not analysed in detail in this study.

4. Work planning. Constructive phases

The obtaining of the total execution timing of the defined works of the project are based on the following premises:

- All the works have been sorted by activity units/groups.
- 8-hours workdays and 22-workdays per month have been considered.

According to all these, the execution term will be 6 months.

5. Health and safety study

In this health and safety study it is detailed:

- The applicable regulations in terms of safety at work, applicable during the execution of the different working units.

- The adopted methodology in order to ensure the adequate accomplishment of the security regulations, their developments and their optimal organisation.

The health and safety budget was 19.344,98 euros.

6. Budget

By applying the unitary prices that appear in the price tables of the resulting measurements, and taking into account the raised items, the material execution budget of the project is 1.227.116,79 euros. Increasing the last value with the corresponding percentages of general expenses and industrial profits, the base tender budget is 1.509.353,65 euros. Adding to this base tender budget the 18% taxes, the contracting execution budget is 1.781.037,31 euros.

7. Prices revision

According to the Royal Decree 1098/2001 about Public Administrations contracts (BOE 26/10/2001), and for being a work contract where the execution term is less than one year, no polynomial price revision formulas specified in the Royal Decree will be used.

8. Documents integrating the project

The current project is formed by the following documents:

DOCUMENT Nº1. Memory and annexes

MEMORY

ANNEXES

ANNEX Nº1. Topography

ANNEX Nº2. Geology and geotechnics

ANNEX Nº3. Layout and stakeout

ANNEX Nº4. Ground moving

ANNEX Nº5. Mobility and traffic study

ANNEX Nº6. Firms and pavements

ANNEX Nº7. Climatology, hydrology and drainage

ANNEX Nº8. Affected services

ANNEX Nº9. Signalling, beaconing and road safety

ANNEX Nº10. Programming works

ANNEX Nº11. Installations

ANNEX Nº12. Prices justification

ANNEX Nº13. Wastes management

ANNEX Nº14. Health and safety study

DOCUMENT Nº2. Maps

DOCUMENT Nº3. Statement of particular technical requirements

DOCUMENT Nº4. Budget

4.1. Budget summary

9. Conclusion

With all the exposed in the memory and the annexes, the project is justified by itself, and therefore it is a must to carry it out.